Opusc. Zool. Budapest, XVI, 1 - 2, 1979

List of Free-living and Plant-parasitic Nematodes Recognized from Egypt hitherto

By

M. M. Abou-El-Naga*

Abstract. 120 species and 2 subspecies belonging to 31 families and 56 genera of free-living and plant-parasitic Nematoda are listed in the present work. These species represent the nematode fauna recorded till now from Egypt. The most abundant genera in order of frequency of occurrence were *Tylenchorhynchus, Pratylenchus, Meloidogyne, Helicotylenchus, Hoplolaimus, Xiphinema, Rhabditis* and *Cephalobus.*

Research work has been conducted for demonstrating the numbers, types and characteristics of nematodes living free and as plant parasitic in Egypt.

Between 1955 and 1962 Oteifa et al. called attention to the circumstance that in cultivated fields and plots a wide range of known plant-parasitic Nematoda were to be found, such as *Meloidogyne* sp., *Tylenchorhynchus* sp., *Xiphinema* sp., and *Rhabditis* sp., as well as a great number of forms living free such as *Acrobeles* sp., *Cephalobus* sp. and *Dorylaimus* sp.

In 1962 the same author registered 10 species belonging to the genus *Pratylenchus* which accompanied the economic crops in Egypt.

In addition, Oteifa (1964) drew up a taxonomic key of the common nematodes accompanying field crops, and described the stand of plant-parasitic nematodes in Egypt. His list includes more than 52 species which accompany economic plants.

Tarjan (1964) described new species belonging to the family Hoplolaimidae, and also listed 38 species of plant-parasitic nematodes in the same year.

Conducting research work on some freshwater samples Andrássy (1958) registered 14 species as new for the Egyptian fauna. Three of these were to be considered new for science, too.

Elmiligy (1970) found two new species belonging to the family Hoplolaimidae, Shafie et al. (1970) could similarly record one new species of the family.

In his M. Sc. thesis Mansour (1972) registered 24 species, out of which 20 were new to the Egyptian fauna.

**Dr. Mohamed M. Abou-El-Naga*, ELTE Állatrendszertani és Ökológiai Tanszék (Zoosystematical and Ecological Institute of the Eötvös Loránd University), 1088 Budapest, VIII. Puskin u. 3.

The present study is intended for a basis of elucidating the present stand of the nematode fauna of Egypt. In order of frequency, the richest genera are as follows: *Monhystera*, *Tylenchorhynchus*, *Helicotylenchus*, *Hoplolaimus*, *Pratylenchus*, *Mylonchulus*, *Mesodorylaimus*, *Longidorus* and *Xiphinema*.

The nematode species were ranked among the nomenclature and identified according to ANDRÁSSY's (1976) system.

120 species and two subspecies of nematodes representing 31 families are listed. The numbers in *italics* after the names of nematodes refer to the literature (see References).

Fam. Monhysteridae

1. **Monhystera elegantula** SCH. STEKHOVEN, 1935 – *3*
2. **M. filiformis** BASTIAN, 1865 – *21*
3. **M. macramphis** FILIPJEV, 1930 – *3*
4. **M. parva** BASTIAN, 1865 – *3*
5. **Theristus borosi** ANDRÁSSY, 1958 – *3*

Fam. Diplolaimelloididae

6. **Diplolaimelloides delyi** ANDRÁSSY, 1958 – *3*

Fam. Cylindrolaimidae

7. **Cylindrolaimus communis** DE MAN, 1880 – *21*

Fam. Plectidae

8. **Plectus sambesii** MICOLETZKY, 1915 – *3*

Fam. Chromadoridae

9. **Chromadora germanica** BÜTSCHLI, 1874 – *3*

Fam. Cephalobidae

10. **Cephalobus persegnis** BASTIAN, 1865 – *2*
11. **Heterocephalobus buchneri** (MEYL, 1953) ANDRÁSSY, 1967 – *21*
12. **H. elongatus** (DE MAN, 1880) ANDRÁSSY, 1967 – *32*
13. **H. teres** (THORNE, 1937) ANDRÁSSY, 1967 – *21*

Fam. Panagrolaimidae

14. **Panagrolaimus wichmanni** RÜHM, 1956 – *2*
15. **Panagrellus dorsobidentatus** (RÜHM, 1956) BAKER, 1962 – *21*

Fam. Rhabditidae

16. **Mesorhabditis spiculigera** (STEINER, 1936) DOUGHERTY, 1953 – *3*
17. **M. ultima** (KÖRNER in OSCHE, 1952) DOUGHERTY, 1955 – *21*
18. **Rhabditis axei** (COBBOLD, 1884) DOUGHERTY, 1955 – *2*
19. **Rhabditolaimus crassus** (KÖRNER, 1954) ANDRÁSSY, 1958 – *2*

Fam. Aphelenchidae

20. **Aphelenchus avenae** BASTIAN, 1865 – *17,28*

Fam. Aphelenchoididae

21. **Aphelenchoides parietinus** BASTIAN, 1865 – *33*

Fam. Anguinidae

22. **Anguina tritici** (STEINBUCH, 1799) CHITWOOD, 1935 – *17,28*
23. **Ditylenchus angustus** (BUTTLER, 1913) FILIPJEV, 1936 – *37*
24. **Pseudhalenchus anchilisposomus** TARJAN, 1958 – *44*

Fam. Psilenchidae

25. **Basiria graminophila** SIDDIQI, 1959 – *44*
26. **Psilenchus aestuarius** ANDRÁSSY, 1962 – *15,44*
27. **P. hilarulus** DE MAN, *21,44*

Fam. Neotylenchidae

28. **Boleodorus thylactus** THORNE, 1949 – *15*

Fam. Tylenchorhynchidae

29. **Merlinius brevidens** (ALLEN, 1955) SIDDIQI, 1970 – *15*
30. **M. nothus** (ALLEN, 1955) SIDDIQI, 1970 – *15*
31. **Tylenchorhynchus brassicae** SIDDIQI, 1961 – *44*
32. **T. capitatus** ALLEN, 1955 – *25*
33. **T. clarus** ALLEN, 1955 – *12, 15, 35*
34. **T. clavicauda** SEINHORST, 1968 – *36,44*
35. **T. cylindricus** COBB, 1913 – *36, 44*
36. **T. dubius** (BÜTSCHLI, 1873) FILIPJEV, 1936 – *33*
37. **T. goffarti** STURHAN, 1966 – *15*
38. **T. kegenicus** LITVINOVA, 1946 – *44*
39. **T. latus** ALLEN, 1955 – *35, 36, 44*
40. **T. martini** FIELDING, 1936 – *25*

Fam. Belonolaimidae

41. **Telotylenchus ventralis** LOOF, 1963 – *44*

Fam. Hoplolaimidae

42. **Helicotylenchus agricola** ELMILIGY, 1970 – *14*
43. **H. cavenessi** SHER, 1966 – *13*
44. **H. digonicus** PERRY, 1959 – *33, 36*
45. **H. dihystera** (COBB, 1893) SHER, 1961 – *13, 33, 36*
46. **H. egyptiensis** TARJAN, 1964 – *43, 44*
47. **H. erythrinae** (ZIMMERMANN. 1904) GOLDEN, 1956 – *25*
48. **H. mangiferensis** ELMILIGY, 1970 – *14*
49. **H. microlobus** PERRY, 1959 – *44*
50. **H. multicinctus** (COBB, 1893) GOLDEN, 1956 – *13, 44*

51. **Hirschmanniella gracilis** (DE MAN, 1880) LUC & GOODEY, 1964 – *25*
52. **H. oryzae** (BREDA DE HAAN, 1902) LUC & GOODEY, 1964 – *44*
53. **Hoplolaimus aegypti** SHAFIE & KOURA, 1970 – *38*
54. **H. columbus** SHER, 1963 – *35, 36, 39*
55. **H. galeatus** COBB, 1913 – *33, 36*
56. **H. pararobustus** (SCH. STEKHOVEN & TEUNISSEN, 1938) SHER, 1963 – *13*
57. **H. tylenchiformis** DADAY, 1905 – *25*
58. **Radopholus similis** (COBB, 1893) THORNE, 1949 – *23, 44*
59. **Rotylenchoides variocaudatus** LUC, 1960 – *33*
60. **Rotylenchulus reniformis** LINFORD & OLIVEIRA, 1940 – *24, 30, 31*
61. **Rotylenchus robustus** (DE MAN, 1876) FILIPJEV, 1936 – *36*
62. **Scutellonema blaberum** (STEINER, 1937) ANDRÁSSY, 1958 – *21*
63. **S. brachyurum** (STEINER, 1938) ANDRÁSSY, 1958 – *44*

Fam. Pratylenchidae

64. **Pratylenchus brachyurus** (GODFREY, 1929) FILIPJEV & SCH. STEKHOVEN, 1941 – *24, 35*
65. **P. coffeae** (ZIMMERMANN, 1898) FILIPJEV & SCH. STEKHOVEN, 1941 – *24*
66. **P. crenatus** LOOF, 1960 – *35, 44*
67. **P. goodeyi** SHER & ALLEN, 1953 – *24*
68. **P. minyus** SHER & ALLEN, 1953 – *24*
69. **P. musicola** (COBB, 1919) FILIPJEV, 1936 – *23*
70. **P. neglectus** (RENCH, 1924) FILIPJEV & SCH. STEKHOVEN, 1941 – *35, 36*
71. **P. penetrans** (COBB, 1917) FILIPJEV & SCH. STEKHOVEN, 1941 – *24, 35, 36*
72. **P. pratensis** (DE MAN, 1880) FILIPJEV, 1936 – *24, 28*
73. **P. scribneri** STEINER, 1943 – *24*
74. **P. thornei** SHER & ALLEN, 1953 – *15, 24, 44*
75. **P. vulnus** ALLEN & JENSEN, 1951 – *24, 35*
76. **P. zeae** GRAHAM, 1951 – *35, 36*

Fam. Heteroderidae

77. **Heterodera glycines** ICHINOHE, 1952 – *15, 41*
78. **Meloidogyne arenaria** (NEAL, 1889) CHITWOOD, 1949 – *10, 30*
78*a* **M. arenaria thamesi** CHITWOOD, 1949 – *10, 30*
79. **M. hapla** CHITWOOD, 1949 – *25*
80. **M. incognita** (KOFOID & WHITE, 1919) CHITWOOD, 1949 – *10, 19, 23*
80*a* **M. incognita acrita** CHITWOOD, 1949 – *10, 32, 30*
81. **M. javanica** (TREUB, 1885) CHITWOOD, 1949 – *7, 8, 11, 22*

Fam. Criconematidae

82. **Hemicriconemoides mangiferae** SIDDIQI, 1961 – *15*
83. **Hemicycliophora oostenbrinki** LUC, 1958 – *25*
84. **H. similis** THORNE, 1955 – *25*
85. **Nothocriconema mutabile** (TAYLOR, 1936) DE GRISSE & LOOF, 1965 – *44*

Fam. Tylenchulidae

86. **Tylenchulus semipenetrans** COBB, 1913 – *32, 36, 44*

Fam. Alaimidae

87. **Alaimus primitivus** DE MAN, 1880 – *2*

Fam. Tripylidae

88. **Tobrilus gracilis** (BASTIAN, 1865) ANDRÁSSY, 1959 – *3*

Fam. Mononchidae

89. **Prionchulus muscorum** (DUJARDIN, 1845) WU & HOEPPLI, 1929 – *21*

Fam. Mylonchulidae

90. **Mylonchulus brachyuris** (BÜTSCHLI, 1845) ALTHERR, 1954 – *21*
91. **M. brevicaudatus** (COBB, 1917) ALTHERR, 1954 – *21*
92. **M. cavensis** (SCHNEIDER, 1940) ANDRÁSSY, 1958 – *21*
93. **M. polonicus** (STEFANSKI, 1915) ANDRÁSSY, 1958 – *3*
94. **M. sigmaturus** (COBB, 1917) ALTHERR, 1953 – *22*

Fam. Anatonchidae

95. **Anatonchus kreisi** MEYL, 1961 – *35*

Fam. Dorylaimidae

96. **Dorylaimus steinerianus** JOHNSTON, 1938 – *21*
97. **Mesodorylaimus aegypticus** (ANDRÁSSY, 1958) ANDRÁSSY, 1959 – *3*
98. **M. centrocercus** (DE MAN, 1880) GERAERT, 1966 – *21*
99. **M. deuberti** (ANDRÁSSY, 1958) GOODEY, 1963 – *12*
100. **M. intervallis** (THORNE & SWANGER, 1936) ANDRÁSSY, 1959 – *3*
101. **Paradorylaimus filiformis** (BASTIAN, 1865) ANDRÁSSY, 1959 – *3*

Fam. Qudsianematidae

102. **Discolaimoides bulbiferus** (COBB, 1906) HEYNS, 1963 – *6*
103. **Eudorylaimus gracilis** (DE MAN, 1876) GOODEY, 1963 – *21*
104. **E. rhopalocercus** (DE MAN, 1876) ANDRÁSSY, 1959 – *21*
105. **E. subacutus** (ALTHERR, 1952) ANDRÁSSY, 1959 – *21*
106. **Labronema estonicum** KRALL, 1957 – *21*

Fam. Aporcelaimidae

107. **Aporcelaimus obscurus** (THORNE & SWANGER, 1936) HEYNS, 1966 – *28*

Fam. Nordiidae

108. **Pungentus silvestris** (DE MAN, 1912) COOMANS & GERAERT, 1962 – *21*

Fam. Longidoridae

109. **Longidorus africanus** MERNY, 1966 – *1*
110. **Longidorus elongatus** (DE MAN, 1876) THORNE & SWANGER, 1936 – *32, 33, 35*
111. **L. laevicapitatus** WILLIAMS, 1959 – *36, 44*
112. **L. taniwha** CLARK, 1963 – *36, 44*

113. **Paralongidorus georgiensis** (TULAGANOV, 1937) SIDDIQI, 1965 – *1, 36, 44*
114. **Xiphinema americanum** COBB, 1913 – *28, 35, 45*
115. **X. arenarium** LUC & DALMASSO, 1964 – *36, 44*
116. **X. elongatum** SCH. STEKHOVEN & TEUNISSEN, 1938 – *36, 44*
117. **X. insigne** LOOS, 1949 – *36, 44*

Fam. Trichodoridae

118. **Trichodorus christiei** ALLEN, 1957 – *25*
119. **T. minor** COLBRAN, 1956 – *36, 44*
120. **T. teres** HOOPER, 1962 – *35, 36, 44*

Acknowledgement

The author wishes to express his deep gratitude to Prof. I. ANDRÁSSY for his encouragement, helpful criticism, and kindness of reviewing the manuscript.

REFERENCES

1. ABOUL-EID, H. Z. (1970): *Systematic notes on Longidorus and Paralongidorus.* – Nematologica, 16: 159 – 179.
2. ALI, M., WAHAB, A. & EL-KIFEL, A. H. (1972): *Nematodes associated with Coleoptera species in Egypt.* – J. Parasitol. Hung., 5: 177 – 201.
3. ANDRÁSSY, I. (1958): *Ergebnisse der zoologischen Aufsammlungen des Ungarischen Naturwissenschaftlichen Museums in Ägypten im Jahre 1957. 2. Nematoden aus ägyptischen Gewässern.* – Ann. – Hist. nat. Hung., 50: 135 – 150.
4. ANDRÁSSY, I. (1976): *Evolution as a basis for the systematization of nematodes.* – Akadémiai Kiadó, Budapest, 1 – 286.
5. COOMANS, A. & LOOF, P. A. (1970): *Morphology and taxonomy of Bathyodontina.* – Nematologica, 16: 180 – 196.
6. DAS, V. M., KHAN, E. & LOOF, P. A. A. (1969): *Revision of the genus Discolaimoides Heyns, 1963, with description of two new species reminiscent of this genus.* – Nematologica, 15: 473 – 491
7. ELGINDI, D. M. (1967): *Influence of pH on hatching and larval emergence of root-knot nematode Meloidogyne javanica.* – Bull. Fac. Agric. Cairo, Univ., 18: 137 – 142.
8. ELGINDI, D. M. (1967): *Evaluation of some sugar-containing amendment of the survival of Meloidogyne larvae.* – Bull. Fac. Agric. Cairo, Univ., 18: 119 – 122.
9. ELGINDI, D. M. & OTEIFA, B. A. (1967): *Preliminary studies on the control of the cotton nematode Tylenchorhynchus latus by D-D, and DBCP nematicides.* – Bull. Fac. Agric. Cairo, Univ., 18: 129 – 135.
10. ELGINDI, D. M. & MOUSSA, F. F. (1971): *Root-knot nematodes in recently reclaimed sandy areas of U. A. R. 11. New host records for root-knot nematodes, Meloidogyne spp.* – Meded. Fac. Landbouw. Rijksuniv. Gent, 36: 1341 – 1344.
11. EL-HELALY, A. F., ABO-EL-DAHAB, M., MICHAIL, S. H. & MEHIAR, F. A. (1968): *Fusarium solani, the cause of a type of damping-off of cotton seedlings in Egypt, with special reference to the role of Meloidogyne javanica on the severity of the disease.* – Compt. Rend. Sec. Journ. Phyt. Phytopharm. Circum-Méditerr., Nice: 180 – 186.
12. ELMILIGY, I. A. (1969): *Redescription of Tylenchorhynchus clarus Allen, 1955.* – Nematologica, 15: 288 – 290.
13. ELMILIGY, I. A. (1970): *On some Hoplolaiminae from Congo and Egypt.* – Meded. Fac. Landbouw. Rijksuniv. Gent, 35: 1141 – 1153.

14. Elmiligy, I. A. (1970): *Three new species of the genus Helicotylenchus Steiner, 1945 (Hoplolaiminae: Nematoda).* – Meded. Fac. Landbouw. Rijksuniv. Gent, 35: 1099 – 1106.

15. Elmiligy, I. A. & Geraert, E. (1971): *Occurrence of some plant-parasitic nematodes belonging to Tylenchida (Nematoda) in Egypt and Congo-Kinshasa.* – Biol. Jaarb., 39: 150 – 156.

16. El-Sherif, M. & Embabi, M. (1975): *The reniform nematode on jasmine in Egypt.* – Plant Disease Rep., 59: 65.

17. Goffart, H. (1951): *Nematoden der Kulturpflanzen Europas.* – Berlin: 1 – 144.

18. Goodey, T. (1932): *The genus Anguillulina Gerv. & v. Ben., 1859, vel Tylenchus Bastian, 1865.* – Journ. Helminthol., 10: 75 – 180.

19. Ibrahim, I. K. A., Ibrahim, I. A. & Massoud, S. I. (1972): *Induction of galling and lateral roots on five varieties of soybeans by Meloidogyne javanica and M. incognita.* – Plant Disease Rep., 56: 882 – 884.

20. Khadr, A. S., Salem, A. A. & Oteifa, B. A. (1972): *Varietal susceptibility and significance of the reniform nematode Rotylenchulus reniformis in Fusarium wilt of cotton.* Plant Disease Rep., 56. 1040 – 1042.

21. Mansour, I. M. (1972): *Magnitude and distribution of soil nematodes in a newly-reclamated area (Nasr City).* – M. Sc. Thesis Al-Azhar Univ. Cairo, Egypt. 1 – 72.

22. Moh, A. S., Nasser, S. H. & Attila, M. S. (1972): *Gawaher (Giza 1) a tomato variety with resistance to the root-knot nematodes.* – Agric. Res. Arab Rep. Egypt, 50: 39 – 45.

23. Oteifa, B. A. (1957): *Nematode root rot of banana.* – Bull. Fac. Agric. Cairo, Univ., 143, 1 – 11.

24. Oteifa, B. A. (1962): *Species of root-lesion nematodes commonly associated with economic crops in the delta of U. A. R.* – Plans Disease Rep., 46: 572 – 575.

25. Oteifa, B. A. (1964): *A taxonomic guide to the common genera of soil and plant nematodes with a supplement on current known economic parasitic species of U. A. R.* – Cont. Nat. centre. 1 – 32.

26. Oteifa, B. A. (1970): *The reniform nematode problem of Egyptian cotton production.* – Journ. Parasit., 56: 255.

27. Oteifa, B. A. (1970): *Systemic pesticides against the cotton reniform in Egypt Intern.* – Congr. Plant Prot. Paris. 192 – 193.

28. Oteifa, B. A. & Abdel Halim, M. F. (1958): *Cropping effect on population dynamics of soil nematodes.* – Bull. Fac. Agric. Cairo, Univ., 128: 1 – 12.

29. Oteifa, B. A. & Elgindi, D. M. (1967): *The nematocidal effieiency of slaked lime $Ca(OH)_2$ in the control of root-knot nematodes of dahlias.* – Bull. Fac. Agric. Cairo, Univ., 18: 123 – 128.

30. Oteifa, B A., Elgindi, D. M. & Moussa, F. F, (1970): *Root-knot problem in recently reclaimed sandy areas of U. A. R. I. Nematode infestation and host range.* – Meded. Fac. Landbouw. Rijksuniv. Gent, 35: 1167 – 1176.

31. Oteifa, B. A., Gibrail, M. A. & Sedky, E. (1970): *Effect of certain carbamated and phosphated pesticides on the soil population density of the Rotylenchus reniformis of cotton Gossypium barbadense.* – Agric. Res. Review, Cairo, 48: 129 – 131.

32. Oteifa, B. A. & Ragab, M. A. (1957): *Soil nematodes and fungi associated with cotton roots.* – Bull. Agric. Fac. Cairo, Univ., 142: 1 – 6.

33. Oteifa, B. A., Rushdi, M. & El-Sharaawi, S. (1964): *A preliminary survey on nematodes associated with cotton fields of Assiut Province with special reference to distribution of parasitic genera.* – Bull. Science and Tech., 7: 205 – 218.

34. Oteifa, B. A. & Sharkawi, A. T. (1972): *Observation on the citrus nematode Tylenchulus semipenetrans Cobb, in U. A. R.* – Nematologica, 8: 267 – 271.

35. Oteifa, B. A. & Taha, A. (1964): *Significance of plant parasitic nematodes in maize deterioration problem.* – Egyptian Agric. Organ. Bah. Exp. Tech. Bull. 73: 1 – 16.

36. Oteifa, B. A. & Tarjan, A. C. (1965): *Potentially important plant-parasitic nematodes present, in established orchards of newly-reclaimed sandy areas of the U. A. R.* – Plant Disease, reporter. 49: 596 – 597.

37. Sasser, J. N. & Janknis, W. R. (1960): *Nematology.* – Chapel Hill, N. C., spec. p. 368 – 369.

38. Shafie, M. F. & Koura, F. (1970): *Hoplolaimus aegypti n. sp. (Hoplolaimidae: Tylenchida) from U. A. R.* – Bull. Zool. Soc. Egypt, 22: 117 – 120.

39. Shafie, M. F. & Osman, A. (1971): *The use of nematicides and acaricides for the control of nematodes and mites in established mango orchards.* – Phytopathol. Mediterr., 10: 271 – 273.

40. Shafie, M. F., Koura, F. & Oteifa, B. A. (1974): *Comparative population dynamics of Pratylenchus zeae and Hoplolaimus aegypti on maize (Zea mays).* – Ann. Agric. Sci. Mosh., 1: 235 – 242.

41. Stelter, H. (1973): *Die Arten der Gattung Heterodera (Nematoda: Tylenchidae) und ihre Verbreitung.* – Pedobiologia, 13: 40 – 61.

42. Steiner, G. (1931): *On the status of the nemic genera Aphelenchus Bastian, Pathoaphelenchus Cobb, Paraphelenchus Micoletzky, Parasitaphelenchus Fuchs, Isonchus Cobb and Seinura Fuchs.* – Journ. Wash. Acad. Sci., 21: 468 – 475.

43. Tarjan, A. C. (1964): *Two new mucronate-tailed spiral nematodes (Helicotylenchus: Hoplolaiminae).* – Nematologica, 10: 185 – 191.

44. Tarjan, A. C. (1964): *Plant parasitic nematodes in the U. A. R.* – FAO Plant Prot., 12: 1 – 8.

45. Tarjan, A. C. (1969): *Variation within the Xiphinema americanum group (Nematoda: Longidoridae).* – Nematologica, 15: 241 – 252.

Opusc. Zool. Budapest, XVI, 1–2, 1979

Revision of the Subfamily Criconematinae Taylor, 1936 (Nematoda)

By

I. Andrássy*

Abstract. The present study analyzes the validity of both nominal taxa, the genus *Criconema* and the species *C. guernei*. *Criconema* should be considered as "genus dubium" and *C. guernei* as "species dubia". For the other species hitherto belonging to *Criconema*, the genus *Ogma* Southern, 1914 is re-established.

According to the four presumably evolutionary trends within Criconematidae, the family is divided into four subfamilies: Hemicycliophorinae, Macroposthoniinae, Criconematinae and Hemicriconemoidinae. From the subfamilies the study particularizes Criconematinae. The diagnoses of the 9 genera belonging to it are given and the species of each genus are enumerated. Besides, keys are added for determining all the species of Criconematinae. Seven new species are described: *Nothocriconema orientale*, *Neolobocriconema cataracticum*, *Ogma spinosum*, *Seriespinula melanesica*, *Seriespinula cactus*, *Pateracephalanema pellitum* and *Crossonema abies* n. spp. A new genus, *Colbranium* n. gen. is erected for a species of *Hemicycliophora* and for the genus *Hemicriconemoides* a new subfamily, Hemicriconemoidinae n. subfam. is proposed. Several new combinations and some new synonyms are established.

Notwithstanding our increasing knowledge concerning the systematization of the family Criconematidae, especially due to examinations performed in the last years by De Grisse, Loof, Raski, and Mehta, there are a good many questions still awaiting for answers. To add some new concepts to the taxonomy of this group of Nematoda, in this paper I propose some modifications on setting up the family Criconematidae and give a revision of the subfamily Criconematinae.

During this study I examined several hundred microscopic slides containing a number of species of Criconematinae originating from twenty countries, viz. *Europe:* Belgium, Holland, Hungary, France, Yugoslavia, Bulgaria; *Asia:* India, Japan; *Africa:* Ghana, Tanzania, Congo Republic, Réunion; *America:* Brazil, Ecuador, Chile, Paraguay; *Oceania:* Australia, New Britain, New Caledonia, Marion Coral Reef. In the rich material I have found seven species which proved to be new to science.

*Dr. István Andrássy, ELTE Állatrendszertani és Ökológiai Tanszék (Zoosystematical and Ecological Institute of the Eötvös Loránd University), 1088 Budapest, VIII. Puskin u. 3.

Criconema, the type genus of the family Criconematidae

In 1889 CERTES described under the name *Eubostrichus guernei* a fresh-water nematode species collected in Tierra del Fuego. Since the genus *Eubostrichus* had been erected by GREEFF (1869) for a group of marine nematodes and CERTES' *guernei* has not proved to be congeneric with the representatives of *Eubostrichus*, HOFMÄNNER and MENZEL established in 1914 the genus *Criconema* for *C. guernei* CERTES, 1889 and the newly described species *C. morgense* HOFMÄNNER in HOFMÄNNER & MENZEL, 1914. In fact, the Swiss authors have created the genus for a third species, too, their "*Criconema guernei*", which represented a separate species and was not congeneric with the one described by CERTES. Unfortunately, HOFMÄNNER and MENZEL committed the error not to name the type of *Criconema*. Observing this, STILES and HASSAL (1920) designated then *Criconema guernei* as type species.

STILES and HASSAL's selection was not a lucky one. They designated such a species to be type of a genus which had been described rather insufficiently and has never been observed since the original description. CERTES characterized his species as follows: „*Eubostrichus guernei* est caracterisée par les ornements de la cuticle, qui la rapprochent des *Eubostrichus* décrits par M. GREEFF, et par le dard dont la bouche est armée. Ce dard est porté sur une longue tige protractile. Le tégument est formé d'anneaux symétriques présentant des angles rentrants et sortants, armés d'épines de manière à former le long du corp six rangées parallèles. La longeur paraît être au maximum de $0^{mm},4$; la largeur varie de $0^{mm},02$ à $0^{mm},4$ et même a $0^{mm},1$, suivant la taille et l'état de concentration des individus examinés."

It was pointed out by TAYLOR (1936), DE GRISSE (1969) and MEHTA & RASKI (1971) that we knew too little about *Criconema guernei*. Studying CERTES' figures the following facts can be gleaned from the original description: body length 0.4 mm, a = 11 – 12; annules of cuticle numerous (about 100, calculated by TAYLOR after the illustrations) and ornamented by spine-like projections arranged in six longitudinal rows; head consisting of a simple rounded annule, spines beginning on the second annule; posterior body end conoid with pointed terminus. Type habitat and locality: detritus from a fresh-water biotope, Tierra del Fuego. From his collections on two Antarctic islands (Kerguelen and Heard Islands), RICHTERS (1908) mentioned later also a species under the name *Eubostrichus guernei*, but he had not enough informations to settle whether his nematodes were actually identical with CERTES' species.

From the description of CERTES it does even not come to light whether his animal was a young or a mature specimen; he has reported nothing about the vulva or the genital organs.

Revising the genus *Criconema* s. lato, MEHTA and RASKI (1971) underlined, that what was known about *C. guernei* was too little for recognizing the species. Even, it is questionable that the spines were in fact arranged in six longitudinal rows, since such number of rows was never observed in any known species of *Criconema* s. lato! At least 8 rows of spines or other appendages are found both on adults and on juveniles. Although KIRJANOVA (1947) described a species showing 4 rows of spines *(Ogma minuta)*, the validity of this number is, however, rather uncertain. It seems to be much more probable that the smallest number of

rows is 8 in Criconematidae. It is supposed therefore that CERTES' nematode also bore at least 8 rows of cuticular outgrowths.

Another thing that makes the species of CERTES practically unrecognizable is that the exact number of cuticle annules is unknown. Being specifically fairly constant, the total number of annules serves in recognition of species as a characteristic of the first rank. In his revision TAYLOR (1936) supposed 100 annules on *guernei*, in a key, however, he said to be "probably 100—120" annules.

Last but not least there is another circumstance that causes *C. guernei* to be questionable: it has remained quite uncertain whether CERTES has described his species on the basis of a mature or only of a young specimen. The position of vulva and the number of postvulvar annules are indispensable in characterising a species. CERTES has mentioned and illustrated, however, neither vulva nor genital organs, so that we can suppose with good reason that CERTES' specimen was a juvenile form. And if so, the structure of cuticle illustrated by him (shape of spines and number of longitudinal rows) was characteristic only for a larval stage of the species *guernei* and not for the mature. When juveniles bear appendages on the cuticle, they do differ in this respect in almost every case from the adults.

From the foregoing it may be established that *Criconema guernei* must be regarded as "species dubia". No type specimen is available and there is no chance whatever that *C. guernei* can ever be identified. And this is not all! Let us inspect *Criconema* more closely as a generic taxon.

As mentioned above and as supposed by HOFMÄNNER & MENZEL (1914), DE GRISSE (1969) and MEHTA & RASKI (1971), it is most likely that *C. guernei* has been described after an immature specimen. And if so, it is hardly to be expected that CERTES' *guernei* would be congeneric with the other species having been described in or transferred to the genus *Criconema*. Even, young animals in this family carry spines or other appendages in such cases, too, when the adults of the same species are smoothly annulated, devoid of any cuticular ornamentation. That case is to be found in the nominal genera *Nothocriconema* DE GRISSE & LOOF, 1965, *Lobocriconema* DE GRISSE & LOOF, 1965 and *Hemicriconemoides* CHITWOOD & BIRCHFIELD, 1957. Owing to the alternating rows of spines, *Hemicriconemoides* has hardly to be taken into considerations but *Nothocriconema* (and *Lobocriconema)* has. There have been described species there, the number of annules on which is near to 100 or more, e. g. *Nothocriconema mutabile* (TAYLOR, 1936) or *N. sphagni* (MICOLETZKY, 1925). At the same time young animals of this genus are ornamented by spine-like scales similar to the ominous species of CERTES.

Let us proceed further. Presuming that the specimen examined by CERTES was yet an adult, it may, because of the number of cuticle annules, scarcely be regarded as congeneric with the other species enlisted up to now in the genus *Criconema*. In these *Criconema* species the number of annules is always less — 51 to 88 — and never reaches one hundred. In the majority of the cases 60—70 annules occur. And what is more, this number is in every case smaller than 100 also in related genera *(Crossonema, Seriespinula, Neolobocriconema, Paracephalanema, Blandicephalanema)*. Summing up all these, the followings can be concluded: *1. C. guernei* was described on the basis of a young animal; *2.* it represents a genus holding spines on cuticle in immature stages only; *3.* it is not congeneric with the other "*Criconema*" species.

It follows that not only the species *guernei* is uncertain but also the genus *Criconema* erected on it. According to our present knowledge this genus can be

identified with none of genera of the subfamily Criconematinae or of the family Criconematidae. Only a single fact seems to be certain, namely that it belongs to the family mentioned above and nothing else. That is all the more reason not to handle *Criconema* longer for "taboo" but to regard it as a "genus dubium". In consequence of the uncertain taxonomic position of *C. guernei*, the type species, all the other species desginated hitherto with the name "*Criconema*" must be provided with other generic name(s).

In the revision of the genus *Criconema* and related genera MEHTA and RASKI (1971) similarly refused to believe *guernei* to be congeneric with other "*Criconema*" species and distinguished therefore two subgenera within *Criconema: Criconema (Criconema* HOFMÄNNER & MENZEL, 1914) and *Criconema (Variasquamata* MEHTA & RASKI, 1971); the former exclusively for *guernei*, the latter for every other *Criconema* species. Thus we have a new generic (subgeneric) name, *Variasquamata*, which could be available – having been *Criconema* rejected and declared as "dubium", respectively – for species named formerly as "*Criconema*", except *guernei*. Nevertheless, many years ago both COBB (1913) and SOUTHERN (1914) erected each a genus for species belonging to this ominous group. COBB proposed his genus *Iota* for the species *I. squamosum*. Unfortunately COBB's animal was likewise a juvenile as CERTES' *guernei* and belonged probably not to *Criconema* in our sense but to *Hemicriconemoides*. Furthermore, the name *Iota* was a homonym, having been already used by SAUSSURE (1855) for a genus of wasps (Vespidae).

However, an other generic name has been published: *Ogma* SOUTHERN, 1914, which must be regarded now as valid. SOUTHERN proposed it for the nematode *O. murrayi*. The name was hitherto out of use since TAYLOR (1936) and most subsequent authors have rejected it thinking its type to be congeneric with *Criconema guernei*. (*Criconema* was described in the same year as *Ogma* but a few months before.) We know, however, that the nominal genus *Criconema* does contain only its uncertain type species, the *guernei*. Other species may not be ranged into it, the genus of SOUTHERN, however, can and must be used for them. *Variasquamata*, being its type – *Criconema (Variasquamata) decalineatum* CHITWOOD, 1957 – congeneric with *Ogma murrayi* SOUTHERN, 1914, must be regarded now as junior synonym of *Ogma*.

Describing *Ogma murrayi*, SOUTHERN proposed simultaneously a new family for it, the Ogmidae. Although this name takes priority of Criconematidae TAYLOR, 1936, I propose in accordance with the Rules of Nomenclature to keep and use TAYLOR's family name also in the future.

Family **Criconematidae** TAYLOR, 1936

Female body small and stout, cigar- or sausage-shaped, straight to curved slightly ventrally, anteriorly blunt, tapering sometimes posteriorly. Cuticle broadly and heavily annulated, annules often retrorse, smooth to finely crenate, or ornamented by scales, spines or other appendages often arranged in longitudinal rows. Annules 24 to 430 in number. Head consisting of one or two annules. Lips minucious, fused into a labial disc, connected with 6 more or less developed elevations, the pseudolips. Spear very long and strong, 45–142 μ. Basal knobs large, metenchium several times as long as telenchium. Median bulb unusually

large, isthmus very short, hardly separated from terminal bulb. Rectum and anus inconspicuous. Ovary prevulvar, mostly straight, without postvulvar sac. Receptaculum seminis present. Vulva far back, well behind 3/4 of total body length.

Male much more slender than female and reduced in organization. Cuticle finely annulated, never possessing appendages. Spear lacking, digestive tract non-functioning. Spicules long and slender. Bursa strongly reduced or absent. Males very rare.

Cuticle of juveniles coarsely annulated, with or without scales or spines; if these are present, they are arranged in longitudinal rows generally more numerous than those of mature females.

Soil inhabiting animals, on or near plant roots, preferring sandy biotopes. Some of the species aquatic or semi-aquatic.

Type genus: *Criconema* TAYLOR, 1936.

The taxonomy of the family Criconematidae has been searched by several authors, but we are especially indebted to DE GRISSE and LOOF. They were, and beside them TAYLOR, too, who have done fundamental works regarding the modern systematization of this very interesting group of Nematoda. In the present article I did not set an aim to give a history of the family or to discuss its system in detail, but I should like only to expound some concepts referring to the subject, and afterwards, I wish to give a somewhat more exhaustive view of the subfamily Criconematinae.

As it was mentioned, DE GRISSE and LOOF gave a good survey about the genera and species of the family Criconematidae. Grouping the species and genera in this family may be arranged from different points of view, keeping however the presumable ways of evolution to the fore, so four evolutionary trends can be distinguished within the Criconematidae. The most ancient way is probably represented by the genera *Hemicycliphora* and *Caloosia*. Tail of both sexes is here generally long (a primitive feature); annules of cuticle not so prominent as in the other groups and smooth both in larval stages and in adults; bursa still present, relatively well developed. As peculiarities the double cuticle on mature females and the strongly curved spicules may be mentioned.

The second trend is represented by genera having coarsely annulated cuticle being however smooth both on larvae and females, or, at most, finely crenate but without scales or spines. Other characteristics: tail already short, bursa reduced, spicules almost straight, cuticle not surrounded by a sheath. *Criconemella*, *Xenocriconemella*, *Criconemoides*, *Macroposthonia*, *Nothocriconemoides* and *Discocriconemella* belong to this group.

The third natural group resembles in several respects to the second one but cuticle is ornamented at least in larval stages but mostly in adults, too, by scale- or spine-like outgrowths arranged on larvae in every case, on females frequently in longitudinal rows. This evolutionary trend is incarnated by *Nothocriconema*, *Neolobocriconema*, *Blandicephalanema*, *Ogma*, *Seriespinula*, *Pateracephalanema*, *Crossonema* and *Croserinema*. Since the very fine, transparent appendages of cuticle and the fact that these outgrowths are not definitely arranged in longitudinal rows on larvae, *Bakernema* differs from the above mentioned genera. It may be supposed, however, that *Bakernema* evolved along the same phylogenetical tendency.

Finally, the fourth line is represented by a single genus, *Hemiriconemoides*. In certain characteristics it seems to show affinities to the first, in other respects to the second or third group. Concerning the shape of the head, the annulation of cuticle and the presence of a cuticular sheath it resembles the *Hemicycliophora*-line, but the spear knobs are already of the type of the other two groups. Larvae have spines not arranged in continuous rows as in the *Ogma* group but being alternate. This latter phenomenon is unique within the whole family. Considering the presumed phylogenetical trends as taxonomic categories, the family Criconematidae can be divided into the following four subfamilies*:

a) Subfamily **Hemicycliophorinae** SKARBILOVICH, 1959. – Criconematidae. Body almost in every case surrounded by a more or less loose external sheath. Annules 140–430, relatively fine, smooth, not retrorse. Lateral field maybe present. Head generally not separate, lips simple, no submedian lobes. Spear very long and slender, knobs rounded, sloping backward. Tail similar in both sexes, usually elongate conoid to filiform, rarely short and rounded. Although males are rudimentary in inner organisation, they resemble more their females than in other subfamilies. Bursa relatively well developed, spicules mostly curved ventrally, semicircular. Cuticle of larvae smooth, without appendages.

Three genera:

Caloosia SIDDIQI & GOODEY, 1963

Colbranium n. gen.

Hemicycliophora DE MAN, 1921
Syn. *Procriconema* MICOLETZKY, 1925

The genus *Colbranium* n. gen. is proposed for *Hemicycliophora truncata* described by COLBRAN (1965) from Australia. By means of the unusually loose cuticle on posterior body region, and, mainly, of the peculiar head separated sharply by a deep incisure from body, this species differs from every other member of *Hemicycliophora*. Type species of the new genus: *Hemicycliophora truncata* COLBRAN, 1965 = *Colbranium truncatum* (COLBRAN, 1965) n. comb.

Key to the genera of Hemicycliophorinae

1 Head narrow with simple annules, not set off, not or only slightly differing from following body annules; cuticular sheath present; spicules semicircularly curved 2
Hemicycliophora DE MAN

– Head broad, set off, conspicuously differing from following body annules; cuticular sheath maybe absent; spicules straight. 2

2 Two cephalic annules set off with hook-like posteriad bent outlines; anterior vulval lip covering flap-like the posterior lip; tail filiform; cuticular sheath maybe absent. .....
Caloosia SIDDIQI & GOODEY

– Only one cephalic annule set off with simple curved outline; anterior vulval lip not forming a flap; tail very short, rounded; cuticular sheath present, unusually loose. . . . **Colbranium** n. gen.

* I cannot agree with *Khan, Chawla* and *Saha* (1976) in separating the two subfamilies Macroposthoniinae and Criconematinae at family level. Both groups are quite closely related each to the other and have also representatives that serve as connecting links between them. Moreover the family name "Madinematidae" proposed by the Indian authors for the first mentioned group is not correct nomenclaturally; instead it the subfamily name Macroposthoniinae *Skarbilovich*, 1959 should be raised to family rank as "Macroposthoniidae".

b) Subfamily **Macroposthoniinae** SKARBILOVICH, 1959. – Criconematidae. Cuticle coarsely annulated, annules 42–200, retrorse, smooth or finely crenate. No cuticular sheath and lateral field on female. Head usually set off, oral disc surrounded by pseudolips often forming four submedian lobes. Spear knobs directed forward. Tail short, conoid or rounded, on male more slender than on female. Bursa strongly reduced or completely absent. Spicules curved slightly ventrally. Males strongly differing in appearance from females. Larval cuticle smooth, at most waved or slightly fringed, without scales or spines arranged in longitudinal rows.

Six genera:

Criconemella DE GRISSE & LOOF, 1965

Criconemoides TAYLOR, 1936

Discocriconemella DE GRISSE & LOOF, 1965
Syn. *Neocriconema* DIAB & JENKINS, 1965

Macroposthonia DE MAN, 1880
Syn. *Mesocriconema* ANDRÁSSY, 1965
Madinema KHAN, CHAWLA & SAHA, 1976 (n. syn.)*

Nothocriconemoides MAAS, LOOF & DE GRISSE, 1971

Xenocriconemella DE GRISSE & LOOF, 1965

Key to the genera of Macroposthoniinae

1 Head annule disc- or saucer-shaped, pseudolips fused; body annules often showing anastomoses. ..... **Discocriconemella** DE GRISSE & LOOF
– Head annule(s) normal, not disc- or saucer-shaped, pseudolips not fused; body annules only exceptionally showing anastomoses. 2

2 Spear very long and flexible, about 40% of total body length; body very small, 0.2–0.3 mm. ..... **Xenocriconemella** DE GRISSE & LOOF
– Spear compared to body length shorter, well under 40% of total body length, mostyl inflexible. 3

3 Body small, about 0.3 mm, densely annulated; number of annules 100–200; no submedian lobes. ..... **Criconemella** DE GRISSE & LOOF
– Body moderate ot large, coarsely annulated; number of annules 40–150; submedian lobes present. 4

4 Vulva open. ..... **Macroposthonia** DE MAN
– Vulva closed. 5

5 Head consisting of three annules: the first very thin and narrow, the second broad and the third narrow again, colar-like; vulva with overhanging anterior lip. ..... **Nothocriconemoides** MAAS, LOOF & DE GRISSE
– Head consisting of a single annule; anterior vulval lip not overhanging. . . **Criconemoides** TAYLOR

c) Subfamily **Criconematinae** TAYLOR, 1936. – Criconematidae. Cuticle broadly and coarsely annulated, without an external sheath. Annules 24–134, retrorse, ornamented – at least in juvenile stages – by scales, spines or finger-

* The characteristics of the type species, *Madinema maglia* Khan, Chawla & Saha correspond well to the criteria of the genus *Macroposthonia*.

like appendages arranged either in longitudinal rows or in continuous transversal fringes. No lateral field on female. Head usually set off, pseudolips present, frequently forming lobes. Spear knobs directed forward. Tail short, conical or rounded, on male slimmer than on female. Bursa reduced, spicules curved slightly ventrally. Males strongly differing in habit from females. Larvae bearing scales or spines on cuticle arranged in longitudinal rows and differing from those of matures in kind and/or in number of rows.

Nine genera*:

Bakernema Wu, 1964

Blandicephalanema Mehta & Raski, 1971

Croserinema Khan, Chawla & Saha, 1976

Crossonema Mehta & Raski, 1971**

Neolobocriconema Mehta & Raski, 1971

Nothocriconema De Grisse & Loof, 1965
Syn. *Lobocriconema* De Grisse & Loof, 1965

Ogma Southern, 1914
Syn. *Criconema* (*Variasquamata* Mehta & Raski, 1971)
Variasquamata (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976

Pateracephalanema Mehta & Raski, 1971

Seriespinula (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
Syn. *Crossonema* (*Seriespinula* Mehta & Raski, 1971)

Genus dubium:

Criconema Hofmänner & Menzel, 1914

Key to the genera of Criconematinae

1 Annules on mature females smooth, without any appendages, at most their posterior margin finely crenate. ..... **Nothocriconema** De Grisse & Loof
– Annules on both juveniles and mature females with scale-, spine, finger- or fringe-like appendages. 2

2 Annules on anterior body region striated with crenate margin, on posterior end ornamented by lobes or other appendages; outgrowths arranged in longitudinal rows may also be present; annules 36 – 52, very broad. ..... **Neolobocriconema** Mehta & Raski
– Annules not striated or crenate, bearing appendages of the same type over entire length of body 3

3 Appendages of cuticle arranged in longitudinal rows. 4
– Appendages of cuticle not arranged in longitudinal rows. 8

4 Appendages mostly in alternating rows, palmate with finger-shaped lobes. ..... **Croserinema** Khan, Chawla & Saha
– Appendages in continuous rows, not alternating, not palmate 5

* The recently described new genus *Merocriconema* Raski & Pinochet, 1976 is closely related to *Neolobocriconema* and most likely identical with it.

** Khan, Chawla and Saha (1976) unnecessarily raised *Crossonema* (*Crossonema*) Mehta & Raski, 1971 to generic rank and proposed superfluously a number of new combinations, since this taxon has been erected already Mehta and Raski on a genus level.

5 Head with submedian lobes ..... **Ogma** SOUTHERN
– Head without submedian lobes. 6

6 Head, compared to body, unusually small, convex with backward bent outline, consisting of one annule. ..... **Blandicephalanema** MEHTA & RASKI
– Head normally large with forward or laterally directed outline, consisting of one, or, mostly of two annules. 7

7 Two head annules; vulval lips closed. ..... **Seriespinula** (MEHTA & RASKI)
– One head annule (only exceptionally two); vulval lips open. .....
Pateracephalanema MEHTA & RASKI

8 Outgrowths of cuticle transparent, membraneous, hardly discernible; head not separate, bearing similar appendages as the other body annules. ..... **Bakernema** WU

– Outgrowths of cuticle definite, well discernible; head separate, smooth or fringed. .....
Crossonema MEHTA & RASKI

d) Subfamily **Hemicriconemoidinae** n. subfam. – Criconematidae. Female body surrounded by double cuticle; annules 50 – 158, not retrorse, fairly flat in outline, without any appendages. No lateral field on female. Head usually not separate, pseudolips hardly developed, not forming median lobes. Spear knobs directed forward. Tail conoid to rounded, short, on male more slender. Cuticle of male simple. Bursa reduced or absent, spicules moderately curved ventrally. Larval cuticle ornamented by scales generally arranged in alternating rows.

One genus:

Hemicriconemoides CHITWOOD & BIRCHFIELD, 1957
Syn. *Iota* COBB, 1913, nec SAUSSURE, 1855

The genera of the subfamily Criconematinae Taylor, 1936

As mentioned above, the genera of the subfamily Criconematinae are especially characterized by the larval cuticle which bear scale- or spine-shaped appendages arranged in longitudinal rows in such cases, too, when the cuticle of mature specimens is devoid of any ornamentation. And it is worth mentioning that, within the same species, the cuticular appendages are very often different in shape and/or in number of rows both on larvae and on adults. Young animals can differ from mature ones in the number of annules, too, being generally greater on the former.

Nothocriconema DE GRISSE & LOOF, 1965

Syn. *Lobocriconema* DE GRISSE & LOOF, 1965.

Criconematinae. Body small to rather large (0.24 – 0.74) mm). Annules 24 – 134, smooth, only exceptionally finely crenate, on the posterior body end very rarely lobed or fringed; outline of annules rounded. Head consisting of one or two annules, the first annule often hat-like and wider than the second annule. Submedian lobes hardly developed or absent. Spear 40 – 132 μ. Vulva on the 4th to 21st annule from terminus, slit-like or completely closed by the overhanging anterior lip. Tail mostly conoid and pointed, sometimes bluntly rounded.

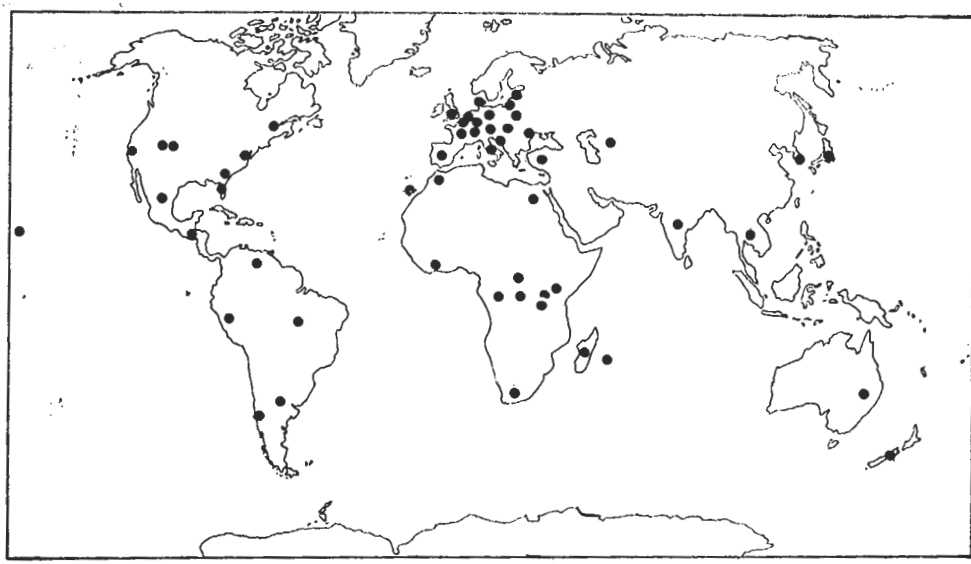


Fig. 1. Distribution of the genus *Nothocriconema* De Grisse & Loof, 1965

Males rare, known in 11 species. Lateral lines 2 – 4. Bursa quite small, strongly reduced.

Up to now the larval forms have been described in 21 species. Cuticle always ornamented by scale-like, mostly pointed appendages arranged in 8 – 24 longitudinal rows.

Mode of life: Most of the species live in the soil though some prefer marshy or swampy biotopes.

Distribution: Except the Antarctic *Nothocriconema* species occur in every continent (Fig. 1). According to our present-day knowledge their distribution shows the following picture: in Europe 10 species *(annulifer, crotaloides, demani, duplicivestitum, longulum, loofi, mutabile, princeps, psammophilum, sphagni)*, in Asia 9 species *(brevicaudatum, cardamomi, demani, jaejuense, kovacsi, mukovum, mutabile, orientale, rarum)*, in Africa 9 species *(corbetti, crassianulatum, dubium, lamellatum, mutabile, pauperum, sabiense, solitarium, victoriae)*, in the Americas 14 species (10 species in North America: *acriculum, crotaloides, demani, kovacsi, lamellatum, longulum, mutabile, permistum, petasum, sphagni;* 6 species in South America: *arcanum, calvum, duplicivestitum, kovacsi, mutabile, pacificum)*, in Australia 4 species *(macilentum, mutabile, pasticum, spinicaudatum)*. The widest distributed species is *N. mutabile*, it has been reported from 22 countries and islands: Holland, England, Italy, Yugoslavia, Spain, Moldavia, Turkey; India; Kenya, Egypt, Marocco, South Africa, Canary Islands, Réunion, Madagascar; United States, Hawaii, Mexico, El Salvador, Venezuela, Peru; Australia. It is followed by *N. annuliferum* from 10 countries: Holland, Belgium, Denmark, Germany, Switzerland, Hungary, France, Yugoslavia, Poland, Estonia and *N. demani* from 11 countries: Holland, Belgium, Denmark, Estonia, Lithuania; Uzbekistan, Korea; United States, Canada, Mexico; Australia. There are six species

that have been observed in three or more countries: *crassianulatum, crotaloides, kovacsi, longulum, princeps, sphagni:* the other *Nothocriconema* species have been found so far from one or two countries only.

Type species: *Hoplolaimus annulifer* DE MAN, 1921 = *Nothocriconema annuliferum* (DE MAN, 1921) DE GRISSE & LOOF, 1965. – 35 species:

N. acriculum RASKI & PINOCHET, 1976

N. annuliferum (DE MAN, 1921) DE GRISSE & LOOF, 1965
Syn. *Hoplolaimus annuliferus* DE MAN, 1921
Criconema annuliferum (DE MAN, 1921) MICOLETZKY, 1925
Criconemoides annulifer (DE MAN, 1921) TAYLOR, 1936
Criconema annuliferum hygrophilum ANDRÁSSY, 1952
Criconemoides hygrophilus (ANDRÁSSY, 1952) OOSTENBRINK, 1960
Nothocriconema hygrophilum (ANDRÁSSY, 1952) DE GRISSE & LOOF, 1965
Criconema stygium SCHNEIDER, 1940 (n. syn.)
Criconemoides stygius (SCHNEIDER, 1940) ANDRÁSSY, 1959
Nothocriconema stygium (SCHNEIDER, 1940) DE GRISSE & LOOF, 1965
Macroposthonia annulata apud KISCHKE, 1956

N. arcanum (RASKI & GOLDEN, 1966) DE GRISSE, 1967
Syn. *Criconemoides arcanus* RASKI & GOLDEN, 1966

N. brevicaudatum (SIDDIQI, 1961) n. comb.
Syn. *Criconema brevicaudatum* SIDDIQI, 1961
Mesocriconema brevicaudatum (SIDDIQI, 1961) ANDRÁSSY, 1965
Criconemoides brevicaudatus (SIDDIQI, 1961) RASKI & GOLDEN, 1966
Lobocriconema brevicaudatum (SIDDIQI, 1961) DE GRISSE, 1967

N. calvum (RASKI & GOLDEN, 1966) DE GRISSE, 1967
Syn. *Criconemoides calvus* RASKI & GOLDEN, 1966

N. cardamomi KHAN & NANJAPPA, 1973

N. corbetti DE GRISSE, 1967
Syn. *Criconemoides corbetti* (DE GRISSE, 1967) LUC, 1970
Lobocriconema patelliferum HEYNS, 1970 (n. syn.)

N. crassianulatum (DE GUIRAN, 1963) n. comb.
Syn. *Criconemoides crassianulatus* DE GUIRAN, 1963
Lobocriconema crassianulatum (DE GUIRAN, 1963) DE GRISSE & LOOF, 1965
Criconemoides deconincki DE GRISSE, 1963

N. crotaloides (COBB, 1924) DE GRISSE & LOOF, 1965
Syn. *Iota crotaloides* COBB, 1924
Criconemoides crotaloides (COBB, 1924) TAYLOR, 1936
Criconema crotaloides (COBB, 1924) SCH. STEKHOVEN & TEUNISSEN, 1938

N. demani (MICOLETZKY, 1925) DE GRISSE & LOOF, 1965
Syn. *Criconema demani* MICOLETZKY, 1925
Criconemoides demani (MICOLETZKY, 1925) TAYLOR, 1936
Criconemoides ravidus RASKI & GOLDEN, 1966

N. dubium De Grisse, 1967
Syn. *Criconemoides dubius* (De Grisse, 1967) Luc, 1970

N. duplicivestitum (Andrássy, 1963) De Grisse & Loof, 1965
Syn. *Criconemoides duplicivestitus* Andrássy, 1963

N. jaejuense Choi & Geraert, 1975

N. kovacsi (Andrássy, 1963) De Grisse & Loof, 1965
Syn. *Criconemoides kovacsi* Andrássy, 1963
Criconemoides siddiqii Khan, 1964 (n. syn.)
Criconemoides californicus Diab & Jenkins, 1966 (n. syn.)

N. lamellatum (Raski & Golden, 1966) De Grisse, 1967
Syn. *Criconemoides lamellatus* Raski & Golden, 1966

N. longulum (Gunhold, 1953) De Grisse & Loof, 1965
Syn. *Criconema longulum* Gunhold, 1953
Criconemoides longulus (Gunhold, 1953) Oostenbrink, 1960
Criconema elegantulum Gunhold, 1953
Criconemoides elegantulus (Gunhold, 1953) Oostenbrink, 1960
Criconemoides quasidemani Wu, 1965
Nothocriconema quasidemani (Wu, 1965) De Grisse & Loof, 1965

N. loofi De Grisse, 1967
Syn. *Criconemoides loofi* (De Grisse, 1967) Luc, 1970

N. macilentum Raski & Pinochet, 1976

N. mukovum Khan, Chawla & Saha, 1976

N. mutabile (Taylor, 1936) De Grisse & Loof, 1965
Syn. *Criconemoides mutabilis* Taylor, 1936
Criconemoides raskii Goodey, 1963
Criconemoides magnoliae Edward & Misra, 1964

N. orientale n. sp.

N. pacificum (Andrássy, 1965) Andrássy, 1967
Syn. *Criconemoides pacificus* Andrássy, 1965

N. paraguayense Andrássy, 1968
Syn. *Criconemoides paraguayensis* (Andrássy, 1968) Luc, 1970

N. pasticum Raski & Pinochet, 1976

N. pauperum (De Grisse, 1967) n. comb.
Syn. *Lobocriconema pauperum* De Grisse, 1967
Criconemoides pauper (De Grisse, 1967) Luc, 1970

N. permistum (Raski & Golden, 1966) De Grisse, 1967
Syn. *Criconemoides permistus* Raski & Golden, 1966

N. petasum (Wu, 1965) De Grisse & Loof, 1965
Syn. *Criconemoides petasus* Wu, 1965

N. princeps (Andrássy, 1962) De Grisse & Loof, 1965
Syn. *Criconemoides princeps* Andrássy, 1962
Criconemoides tribulis Raski & Golden, 1966

N. psammophilum Krnjaic & Loof, 1973

N. rarum (Boonduang & Ratanaprapa, 1974) n. comb.
Syn. *Lobocriconema rarum* Boonduang & Ratanaprapa, 1974

N. sabiense (Heyns, 1970) n. comb.
Syn. *Lobocriconema sabiense* Heyns, 1970

N. solitarium De Grisse, 1967
Syn. *Criconemoides solitarius* (De Grisse, 1967) Luc, 1970

N. sphagni (Micoletzky, 1925) De Grisse & Loof, 1965
Syn. *Criconema sphagni* Micoletzky, 1925
Criconemoides sphagni (Micoletzky, 1925) Taylor, 1936
Criconemoides grassator Adams & Lapp, 1967

N. spinicaudatum Raski & Pinochet, 1976

N. victoriae Heyns, 1970

Note: Because of its head shape *Nothocriconema coorgi* Khan & Nanjappa, 1973 does probably not belong to this genus. Recently Ivanova has described two further species: *Nothocriconema alticola* Ivanova, 1976 and *N. vallicola* Ivanova, 1976; on basis of the structure of head, vulva and larval cuticle they seem, however, to belong to the genus *Criconemoides*.

Nothocriconema can be distinguished from all genera of the subfamily Criconematinae by having no appendages on the cuticle in mature stage. At most, the annules are finely striated with crenate margin or, very rarely, lobed or fringed on the posterior body end. On the other hand, *Nothocriconema* differs from the other smooth-annuled genera (Macroposthoniinae) in having cuticular outgrowths on larvae arranged in longitudinal rows.

In a book on the systematization of nematodes (1976) I mentioned the genus *Lobocriconema* De Grisse & Loof, 1965 as a junior synonym of *Nothocriconema;* today I am of the same opinion. De Grisse and Loof have established *Lobocriconema* for such *Nothocriconema*-like species which have small submedian lobes on the oral field and relatively few annules. Meanwhile, a part of the species enlisted here has been transferred to the genus *Nothocriconema* but the remaining species also cannot be separated in my opinion from the representatives of *Nothocriconema*. The submedian lobes mentioned above are namely extremely small, hardly perceptible from even frontal view, too. Similar small lobes can be observed also on some *Nothocriconema* species. Some species have described which serve as connecting link between both nominal genera, e. g. *Nothocriconema lamellatum* (Raski & Golden, 1966) and *Lobocriconema patelliferum* Heyels, 1970. The former has few annules but no submedian lobes, whereas the latter many annules and small submedian lobes, too. Moreover there exist two species — one have been described in the genus *Nothocriconema*, the other in *Lobocriconema* — which cannot be separated from each other: *N. corbetti* De Grisse, 1967 and *L. patelliferum* Heyns, 1970; they must be regarded as synonyms. On the basis of all these I do not think it justified to separate *Lobocriconema* from *Nothocriconema*.

1 Annules 85–134. 2
– Annules 24–84. 11

2 Spear 110–130 μ long. 3
– Spear shorter than 100 μ 4

3 Number of annules 104–134; vulva on the 18th–21st annule from posterior end. – L = 0.44–0.57 mm; V = 82–88%; R = 104–134; RV = 18–21; spear = 122–132 μ ..... **macilentum** RASKI & PINOCHET
– Number of annules 87–103; vulva on the 13rd–17th annule from posterior end. – L = 0.30–0.56 mm; V = 84–89%; R = 87–103; RV = 13–17; spear = 110–130 μ. ..... **sphagni** (MICOLETZKY)

4 Tail elongate-conoid, terminus with string-like arranged small annules; spear under 60 μ L = 0.36–0.41 mm; V = 86–89%; R = 83–92; RV = 13–16; spear = 50–58 μ. ..... **acriculum** RASKI & PINOCHET
– Tail not so elongate, last annules not string-like; spear 60 μ or more (only exceptionally shorter). 5

5 Head with two annules, the second annule directed forward or aside. 6
– Head with one annule, the second annule directed backward. 8

6 Spear short, smaller than 50 μ; vulva on the 7th–8th annule. – L = 0.34–0.45 mm; V = 90–93%; R = 105–111; RV = 7–8; spear = 40–48 μ. **mukovum** KHAN, CHAWLA & SAHA
– Spear longer than 60 μ; vulva on the 10th–15th annule. 7

7 Vulva closed, with overhanging anterior lip; spear between 80 and 100 μ. – L = 0.47–0.59 mm; V = 87–91%; R = 85–97; RV = 10–14; spear = 81–101 μ. ..... **psammophilum** KRNJAIC & LOOF
– Vulva open, anterior lip not overhanging; spear shorter than 75 μ. – L = 0.37–0.49 mm; V = 87–89%; R = 90–95; RV = 13–15; spear = 62–74 μ. . . **arcanum** (RASKI & GOLDEN)

8 Spear 73–82 μ long. – L = 0.27–0.39 mm; V = 87–90%; R = 94–111; RV = 12–17; spear = 73–82 μ. ..... **pasticum** RASKI & PINOCHET
– Spear 48–70 μ long 9

9 Postvulval portion of body twice as long as body diameter at vulva; annules 93. – L = 0.47 mm; V = 88%; R = 93; RV = 14; spear = 62 μ. ..... **pacificum** (ANDRÁSSY)
– Postvulval portion of body at most one and a half times as long as body diameter at vulva; annules more. 10

10 Vulva on the 8th–12th annule; scales on larval cuticle arranged in 15–17 longitudinal rows. – L = 0.25–0.58 mm; V = 89–95%; R = 95–123; RV = 8–12; spear = 48–70 μ. ..... **mutabile** (TAYLOR)
– Vulva on the 12th–15th annule; scales on larval cuticle arranged in 24 longitudinal rows. – L = 0.30–0.51 mm; V = 86–93%; R = 97–118; RV = 12–15; spear = 59–70 μ. ..... **kovaesi** (ANDRÁSSY)

11 Head annule hat-like, conspicuously wider than the 2nd annule. 12
– Head annule not wider than the 2nd annule, often even narrower 20

12 Annules 39–42, with finely crenate margin. 13
– Annules 50–78, with smooth margin. 14

13 Outline of head annule curved backward. – L = 0.47 mm; V = 87%; R = 39; RV = 5; spear = 62 μ. ..... **sabiense** (HEYNS)*
– Outline of head annule curved forward. – L = 0.49 mm; V = 92–95%; R = 42; RV = 5; spear = 58 μ. ..... **brevicaudatum** (SIDDIQI)*

14 Spear long, between 86 and 120 μ 15
– Spear short, between 50 and 85 μ. 18

15 Postvulval body region elongate, twice as long as vulval body diameter. 16
– Postvulval body region about one and a half times as long as vulval body diameter. 17

* It might well be that *brevicaudatum* and *sabiense* are one and the same species.

16 Last 5–7 annules arranged in a string-like file, small; number of annules 60–65. – L = 0.44–0.62 mm; V = 84–89%; R = 60–65; RV = 10–12; spear = 100–120 μ. ..... **cardamomi** KHAN & NANJAPPA

– Last annules of the usual form, not string-like; number of annules 68–76. – L = 0.59–0.74 mm; V = 84–89%; R = 68–76; RV = 11–14; spear = 95–108 μ. .. **crotaloides** (COBB)

17 On both sides of body each annule is marked by an inverted V. – L = 0.29–0.57 mm; V = 80–91%; R = 50–63; RV = 9–11; spear = 86–113 μ. ..... **princeps** (ANDRÁSSY)

– No such inverted V present on annules. – L = 0.40–0.68 mm; V = 87–92%; R = 55–78; RV = 7–11; spear = 89–113 μ. ..... **annuliferum** (DE MAN)

18 Tail conoid, pointed. 19

– Tail blunt. – L = 0.41 mm; V = 90%; R = 52; RV = 6; spear = 59 μ. **solitarium** DE GRISSE

19 Spear 50–53 μ; annules more than 60; vulva on the 6th to 8th annule from the posterior end. – L = 0.31–0.40 mm; V = 88–90%; R = 61–66; RV = 6–8; spear = 50–53 μ..... **victoriae** HEYNS

– Spear 75–85 μ; annules less than 60; vulva on the 11th to 12th annule from the posterior end. – L = 0.42–0.49 mm; V = 87%; R = 53–58; RV = 11–12; spear = 75–85 μ. .... **jaejuense** CHOI & GERAERT

20 Annules either on the whole body finely striated and crenate or at most on the posterior end lobed or fringed. 21

– Annules smooth. 25

21 Annules finely striated and crenate in total length of body. 22

– Annules mostly smooth, only on the posterior body region lobed and fringed, respectively. ...24

22 Number of annules small: 24–25. – L = 0.32–0.53 mm; V = 95–97%; R = 24–25; RV = 3; spear = 78–90 μ. ..... **pauperum** DE GRISSE

– Number of annules more than 30. 23

23 Annules 33–43; larva with 8 rows of spines. – L = 0.24–0.45 mm; V = 91–94%; R = 33–43; RV = 4–7; spear = 51–85 μ. ..... **crassianulatum** (DE GUIRAN)

– Annules 49–56; larva with 13 rows of spines. – L = 0.40–0.47 mm; V = 93–95%; R = 49–56; RV = 4–5; spear = 80–84 μ. ..... **lamellatum** (RASKI & GOLDEN)

24 Posterior body end cupola-shaped with abruptly narrowing tail; vulva on the 10th–12th annule; spear longer than 70 μ. – L = 0.36–0.50 mm; V = 89–92%; R = 76–86; RV = 10–12; spear = 70–82 μ. ..... **spinicaudatum** RASKI & PINOCHET

– Posterior body end conoid, tail not narrowing abruptly; vulva on the 6th–7th annule; spear shorther than 60 μ. – L = 0.33–0.41 mm; V = 92–94%; R = 62–74; RV = 6–7; spear = 45–58 μ. ..... **corbetti** DE GRISSE

25 Spear shorter than 60 μ. 26

– Spear longer than 60 μ. 27

26 Head consisting of two annules; tail strongly drawn out; anterior vulval lip overhanging. – L = 0.34–0.42 mm; V = 83–85%; R = 79–84; RV = 14–16; spear = 51–53 μ. ..... **orientale** n. sp.

– Head consisting of one annule only; tail not drawn out; anterior vulval lip not overhanging. – L = 0.39–0.44 mm; V = 84–87%; R = 76–79; RV = 12–14; spear = 53–58 μ..... **paraguayense** ANDRÁSSY

27 50–60 annules. 28

– 65–80 annules. 29

28 Oral field standing out from the outline of the head annule; vulva on the 8th–9th annule; larva with 8 rows of scales. – L = 0.34–0.40 mm; V = 88–90%; R = 55–60; RV = 8–9; spear = 66–72 μ. ..... **duplicivestitum** (ANDRÁSSY)

– Oral field not standing out of the outline of head annule; vulva on the 10th–12th annule; larva with 12 rows of scales. – L = 0.55–0.58 mm; V = 82%; R = 50–55; RV = 10–12 spear = 73–75 μ. ..... **petasum** (WU)

29 Posterior end of body rounded, postvulval region about as long as vulval body diameter. – L = 0.35–0.43 mm; V = 93%; R –73–74; RV = 8; spear = 81 μ. .. **dubium** DE GRISSE

– Posterior end of body conoid, terminus pointed, postvulval region 2–3 times as long as vulva body diameter. 30

30 Last 5–6 annules string-like, rounded; postvulval region two and a half to three times as long as vulval body diameter. – L = 0.30–0.57 mm; V = 81–89%; R = 67–85; RV = 13–18; spear = 62–87 μ. ..... **longulum** (Gunhold)
– Only the last 2 (–3) annules string-like, rounded; postvulval region twice as long as vulval body diameter. 31

31 Body over 0.5 mm; vulva on the 8th–13th annule. – L = 0.51–0.63 mm; V = 87–90%; R = 68–75; RV = 8–13; spear 89–99 μ. ..... **loofi** De Grisse
– Body under 0.5 mm; vulva on the 12th–16th annule. 32

32 Spear 60–75 μ long. – L = 0.38–0.50 mm; V = 84–86%; R = 65–77; RV = 12–15; spear = 60–75 μ. ..... **demani** (Micoletzky)
– Spear 77–106 μ long. 33

33 Oral field more or less plain, submedian pseudolips somewhat lobiform. – L = 0.34–0.46 mm; V = 83–85%; R = 79–81; RV = 15–16; spear = 92–106 μ. ..... **calvum** (Raski & Golden)*
– Oral field convex, submedian pseudolips not lobiform. – L = 0.27–0.40 mm; V = 84–88 %; R = 75–87; RV = 12–15; spear = 77–102 μ. ..... **permistum** (Raski & Golden)*

Nothocriconema orientale n. sp.

(Fig. 2 A–G)

23 ♀: L = 0.34–0.42 mm; a = 10.5–13.4; b = 3.8–4.3; c = 9.0–10.2; V = 83–85%.

Holotype ♀: L = 0.37 mm; a = 11.7; b = 3.8; c = 9.0; V = 85%.

Body slightly curved ventrally, consisting of 79–84 (in most of cases of 82) annules. From head to posterior end of oesophagus 20–23, to vulva 65–71 (mostly 68) annules are present. Spear 11–12 annules long. Annules smooth, sloping backward, in the middle region of body 5–6 μ thick and 31–34 μ wide.

Head consisting of two annules with forward directed margins; they are thinner than 3rd annule (4.5–6.5 μ thick together). The first annule is always somewhat narrower than second one, viz. 9–11 μ and 12–13 μ, respectively. Third annule 15–18 μ wide. Oral field flat, bearing small, weakly developed submedian lobes.

Spear strong, relatively short, 51–53 μ, 12–15 per cent of the total body length. Basal knobs 5.5–6.5 μ broad; metenchium 82–84%. Middle bulb about as long as isthmus and terminal bulb together. Excretory pore difficult to observe, on the 24th–25th annule from the anterior end.

Vulva on the 14th–16th annule from the tail terminus, closed with overhanging anterior lip. It seems very characteristic to be for the species that from lateral view the prevulval annule sits as a small papilla on the anterior vulva lip (Figs. 2 E–F). Receptaculum seminis oviform, filled with sperms. Vulval diameter 27–29 μ, postvulval body portion 2.2–2.5 times as long as this diameter. Anus on the 9th–11th annule from the terminus. Tail 37–43 μ long, conoid. Terminus with 4–5 small, rounded, string-like annules.

Male not observed.

In the material I have found two larvae. The 3rd-stage larve 0.31 mm long with 85 annules, the 4th-stage larve bearing 91 annules. Cuticle ornamented by double-pointed scales beginning on the 3rd annule and arranged in 14 longitudi-

* Probably identical species; it is very difficult to separate them.

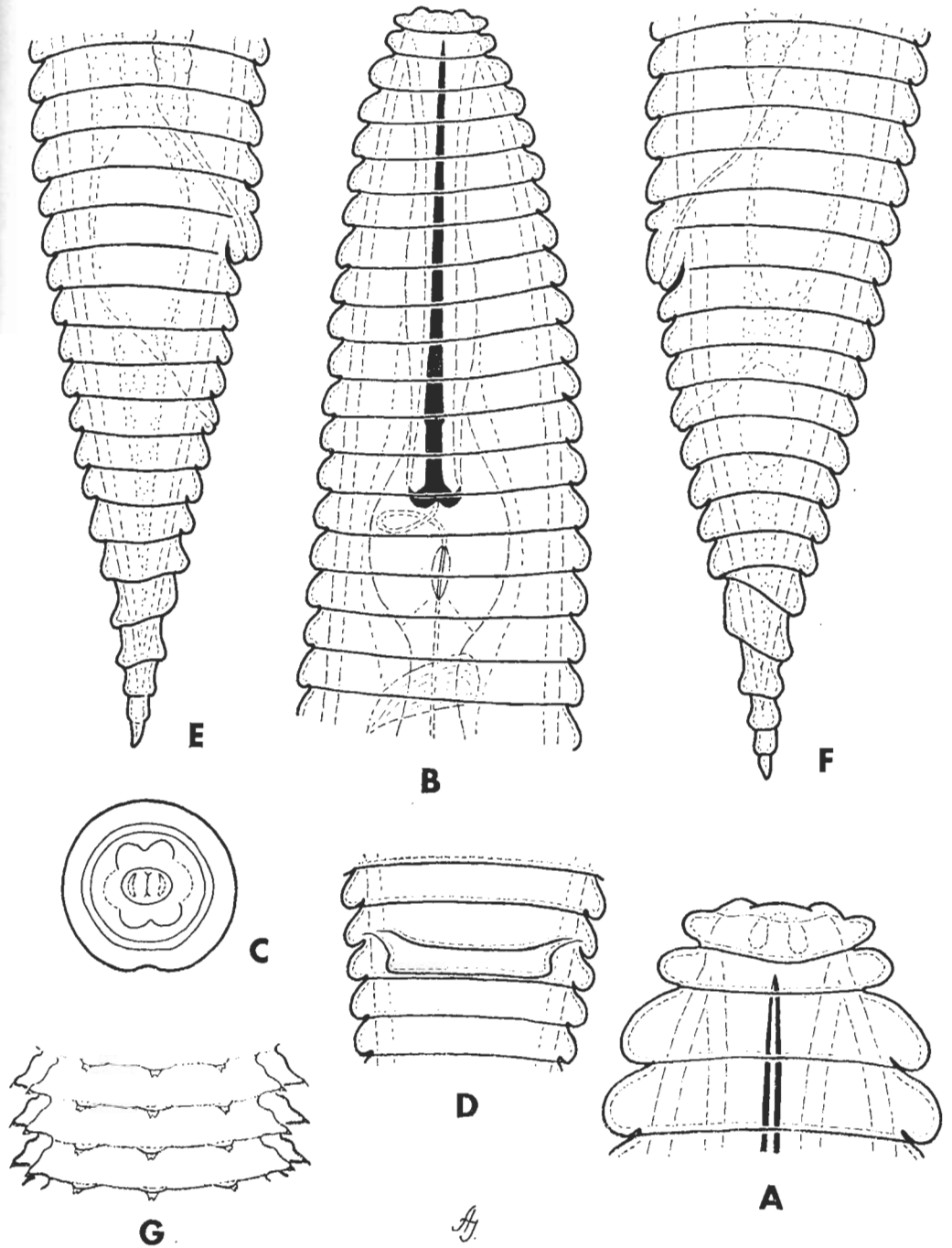


Fig. 2. *Nothocricotopus orientale* n. sp. *A:* Head (2500×); *B:* Anterior end of body (1250×); *C: En face* view (2500×); *D:* Vulva region, ventral view (1250×); *E – F:* Posterior end, females (1250×); *G:* Surface of annules on mid-body, 4th-stage larve

nal rows. Scales standing out from the contour of cuticle only on the 4th-stage larve, on the 3rd-stage they are covered by a fine cuticular sheath left over from the last moulting.

Holotype: ♀ on slide Nr. A – 8373. Holotype and paratypes (20 ♀♀ and 2 juveniles) in the collection of the author, and one paratype each in the collection of Dr. De Grisse (Rijkslandbouwhogeschool, Leerstoel voor Dierkunde, Gent, Belgium) and of Dr. P. A. A. Loof (Laboratorium voor Nematologie, Wageningen, Holland), respectively.

Type habitat and locality: Fallen leaves in an *Abies-Tsuga-Betula*-forest in 2200 m height above sea level, Mt. Yokodake, Nagamo Prefecture, Japan; collected by Prof. Dr. H. Franz (Wien), June, 1974.

In the number of cuticle annules and the relatively short spear *Nothocriconema orientale* n. sp. is most closely related to *N. paraguayense* Andrássy, 1968, but it can be separated from the South American species by the double-annuled head (one annule on *paraguayense)*, the overhanging anterior vulval lip, the strongly narrowing tail, the number of the small, string-like terminal rings (4 – 5 at *orientale* and 1 – 2 at *paraguayense*, respectively) and the somewhat shorter spear (55 – 58 μ at *paraguayense)*. On the basis of its long tail, double-ringed head and number of annules *N. orientale* resembles also *N. longulum* (Gunhold, 1953), its spear is however much shorter (62 – 87 μ at *longulum)*, the posterior portion of oesophagus longer and the larva has more numerous rows of scales (11 rows at *longulum)*. Besides, the prevulval annule, shifted papilliform on the anterior lip of vulva, is a characteristic feature by which the new species can easily be recognized.

Neolobocriconema Mehta & Raski, 1971

Criconematinae. Robust species of medium size (0.34 – 0.75 mm). Body with few annules: 36 – 52, these broad with sloping margin, and with fine striae or incisures. Annules either on the whole body finely or heavily serrated or fringed, or at most on the posterior end irregularly lobed. Besides these markings longitudinal grooves or bulges can also occur on the cuticle. Head of one annule with smooth, laterally or slightly forward directed margin. The second annule is attached to the other body annules. Oral field showing small submedian lobes. Spear 65 to 122 μ long. Vulva closed, on the 3rd-8th annule from the tail terminus, its lips conical. Posterior body region blunt or blunt-conoid.

Male is known in one species only. Lateral incisures 4. Bursa present but rudimentary.

Young animals generally with more annules than adults. Cuticular scales arranged in 8, 12 or 16 rows.

Mode of life: Soil inhabiting animals.

Distribution (Fig. 3): Most of species have been described or recorded from Asia, viz. 3 species from India *(aberrans, laterale, serratum)*, 3 from Korea *(aberrans, insulicum, serratum)* and 1 from Uzbekistan *(insulicum)*. Recently I have found a species in South America *(cataracticum)*.

Type species: *Criconema laterale* Khan & Siddiqi, 1964 = *Neolobocriconema laterale* (Khan & Siddiqi, 1964) Mehta & Raski, 1971.

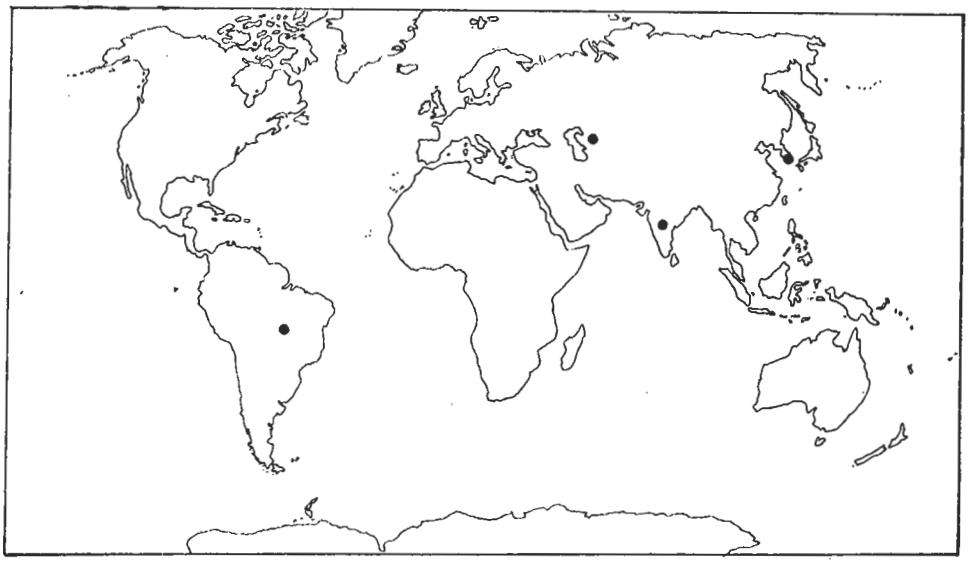


Fig. 3. Distribution of the genus *Neolobocriconema* MEHTA & RASKI, 1971

5 species:

N. aberrans (JAIRAJPURI & SIDDIQI, 1963) n. comb.
Syn. *Criconemoides aberrans* JAIRAJPURI & SIDDIQI, 1963
Lobocriconema aberrans (JAIRAJPURI & SIDDIQI, 1963 (DE GRISSE & LOOF, 1965

N. cataracticum n. sp.

N. insulicum CHOI & GERAERT, 1975

N. laterale (KHAN & SIDDIQI, 1964) MEHTA & RASKI, 1971
Syn. *Criconema laterale* KHAN & SIDDIQI, 1964
Lobocriconema laterale (KHAN & SIDDIQI, 1964) DE GRISSE & LOOF, 1965
Criconemoides lateralis (KHAN & SIDDIQI, 1964) RASKI & GOLDEN, 1966

N. serratum (KHAN & SIDDIQI, 1963) MEHTA & RASKI, 1971
Syn. *Criconema serratum* KHAN & SIDDIQI, 1963
Lobocriconema serratum (KHAN & SIDDIQI, 1963) DE GRISSE & LOOF, 1965
Criconemoides serratus (KHAN & SIDDIQI, 1963) RASKI & GOLDEN, 1966
Criconema sulcatum GOLDEN & FRIEDMAN, 1964
Lobocriconema sulcatum (GOLDEN & FRIEDMAN, 1964) DE GRISSE & LOOF, 1965
Criconemoides sulcatus (GOLDEN & FRIEDMAN, 1964) RASKI & GOLDEN, 1966

Neolobocriconema occupies a place between the genus *Nothocriconema* (annules of mature specimens still smooth, without ornamentation, or, very rarely, with a few lobes on the posterior end only) and the other genera of Criconematinae (annules of mature specimens marked by scales or spines in the whole length of body).

Key to the species of Neolobocriconema

1 Annules with bulges or lobes arranged in 12–16 longitudinal rows. 2
– Annules without definite lobes, only with small fringes not arranged in longitudinal rows. 3

2 Number of annules about 50; cuticular lobes on the posterior body region long, single-pointed; spear shorter than 80 μ. – L = 0.45–0.54 mm; V = 88–90%; R = 48–52; RV = 5–6; spear = 73–75 μ. ..... **insulicum** (CHOI & GERAERT)
– Number of annules under 40; cuticular lobes on the posterior body region short, multi-pointed; spear about 90 μ. – L = 0.50–0.60 mm; V = 90–94%; R = 36–38; RV = 4–5; spear = 90–96 μ. ..... **serratum** (KHAN & SIDDIQI)

3 Head saucer-shaped (*Discocriconemella*-like); vulva on the 3rd annule from terminus. – L = 0.34–0.44 mm; V = 94%; R = 39–42; RV = 3; spear = 94–102 μ. ..... **cataracticum** n. sp.
– Head normal, not saucer-shaped; vulva on the 4th–5th annule from terminus. 4

4 Margins of annules heavily fringed with small irregular finger-like appendages interrupted by deep lateral grooves; spear above 100 μ. – L = 0.55–0.75 mm; V = 91–94%; R = 37–41; RV = 4–5, spear = 110–122 μ. ..... **laterale** (KHAN & SIDDIQI)
– Margins of annules only slightly crenate and not interrupted by lateral grooves; spear under 80 μ. – L = 0.45–0.54 mm; V = 92–95%; R = 38–43; RV = 4–5; spear = 68–78 μ. **aberrans** (JAIRAJPURI & SIDDIQI)

Neolobocriconema cataracticum n. sp.

(Figs. 4 A–D and 5 A–C)

3 ♀: L = 0.34–0.44 mm; a = 5.5–6.8; b = 2.5–3.2; c = ?; V = 94%.

Body small and very plump with 39–42 annules. Annules 8.5–11 μ thick and 62–65 μ wide on the middle region of body. They are ornamented by fine longitudinal incisures and numerous short lobes or appendages numbering 120–150 on one annule. First 5–6 annules still without appendages, only waved, lobes beginning to separate after these annules. The lobules are as long to twice as long as wide but on the last 5–6 annules becoming enlarged, finger-shaped. Owing to the adhered soil particles each annule seems to be darker in its posterior half.

Head of unusual shape for the subfamily Criconematinae: disc-like or saucer-shaped like in the genus *Discocriconemella*, consisting of a thick annule (6–8 μ thick and 19–21 μ wide). Second annule directed backward and nearly as wide as the first annule. The last two annules on tail become irregular, tri-lobed; lobes of terminal annule bearing 3–5 finger-shaped lobules.

Spear 94–102 μ (12–13 annules) long, 23–27% of the total body length. Basal knobs 12–13 μ wide; metenchium 79–80% of the spear length. Middle bulb comparatively small, about as long as isthmus and terminal bulb together. Between head and proximal oesophagus end 15–17 body annules. Excretory pore on the 16th annule from the anterior end.

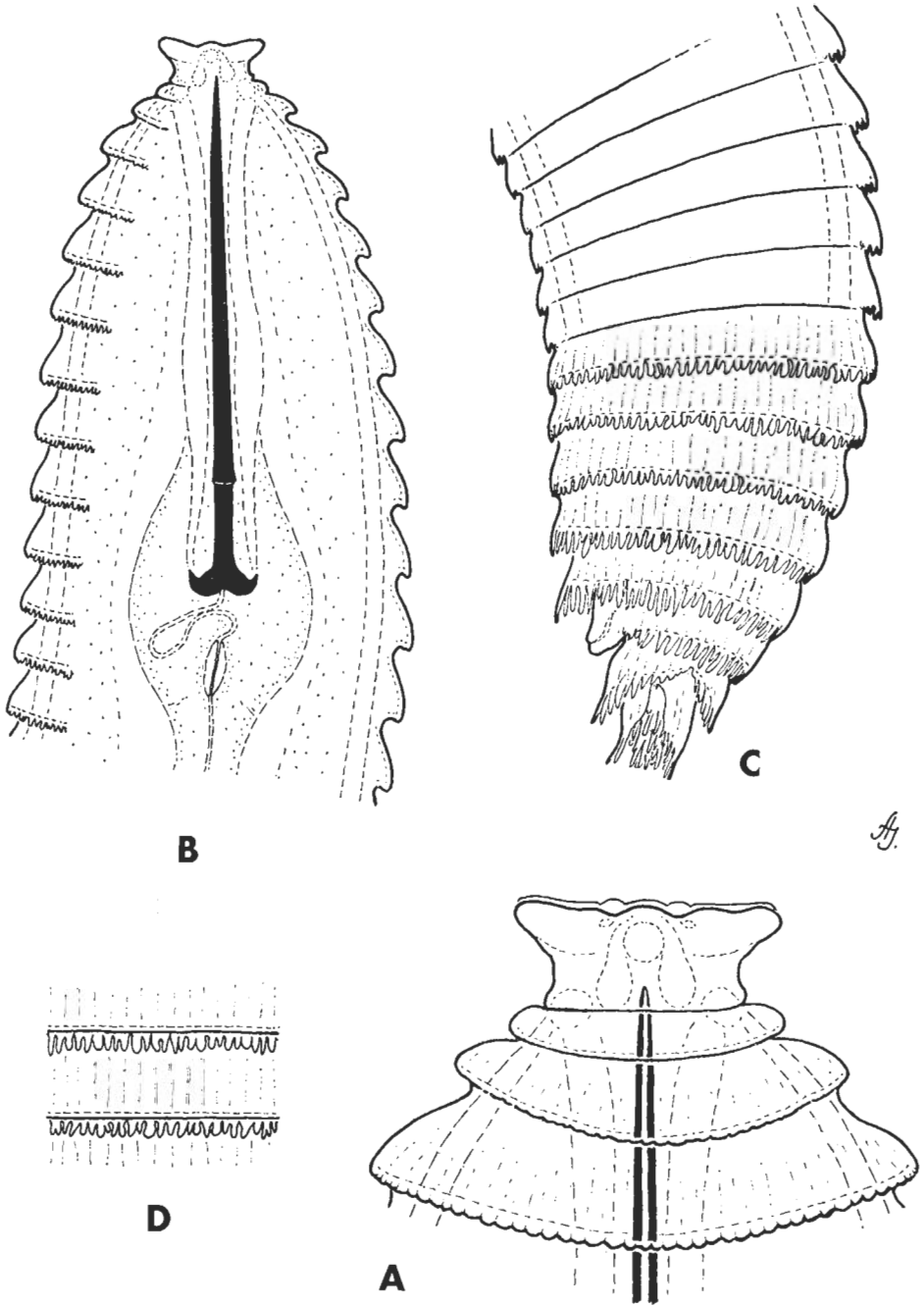


Fig. 4. *Neolobocriconema caturacticum* n. sp. *A:* Head (1650×); *B:* Anterior end of body (700×); *C:* Posterior end of body (700×); *D:* Annules showing fine longitudinal striae and short lobes, mid-body

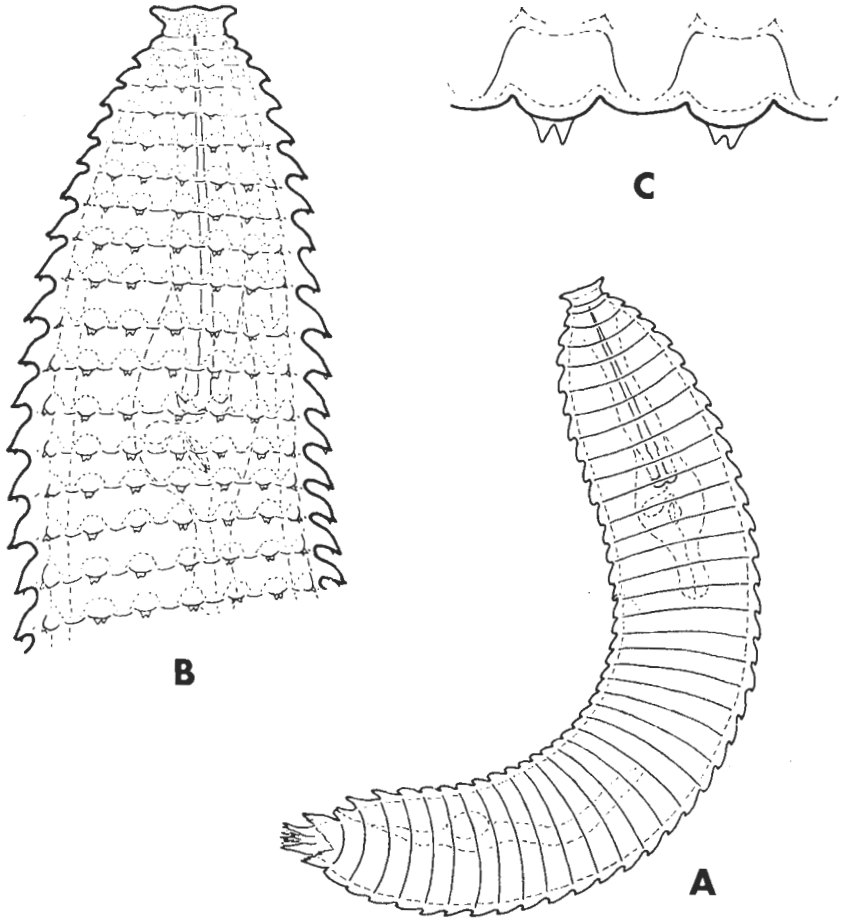


Fig. 5. *Neolobocriconema cataracticum* n. sp. *A: In toto* view (270×); *B:* Anterior end of the 4th stage larve (700×); *C:* Scales of the same larve

Vulva conical, closed, on the 3rd annule from terminus, its posterior lip a little longer than the anterior one. Anus between the two last annules. Postvulval body portion 20 – 24 μ long.

Male unknown.

Body of the fourth-stage larva consisting of 45 – 46 annules, somewhat more than that of mature. Annules ornamented by double-tipped scales arranged in 16 longitudinal rows. On the third-stage larve there are however only 12 rows of scales.

Holotype: ♀ on slide Nr. A – 6215. Holotype and paratypes (2 ♀♀ and 3 juveniles) in the collection of the author.

Type habitat and locality: Red rain forest soil in the Iguaçu National Park, in the vicinity of the world-famous cataracts of the River Iguaçu, Brazil. Collected in December, 1965 by the author.

In the new species, *Neolobocriconema cataracticum* n. sp., the characteristics of the genera *Discocriconemella* De Grisse & Loof, 1965 and *Neolobocriconema*

MEHTA & RASKI, 1971 are curiously combined. In the construction of head it resembles *Discocriconemella*, in the small number and ornamentation of annules however it seems to be a *Neolobocriconema*. Just these latter characteristics, furthermore the very plump body shape, the far back standing vulva and scales-bearing larval cuticle support my placing this interesting nematode into the genus *Neolobocriconema*. The new species can be distinguished from all known members of the genus by the peculiar head, the structure of cuticle, the long spear and the back position of vulva.

Ogma SOUTHERN, 1914

Syn. *Criconema* (*Variasquamata* MEHTA & RASKI, 1971); *Variasquamata* (MEHTA & RASKI, 1971) KHAN, CHAWLA & SAHA, 1976.

Criconematinae. Body small to moderate (0.27 – 0.86 mm), stout; straight or only slightly curved ventrally. Number of annules 51 – 88. Annules ornamented by scales or rounded or pointed (single-tipped) appendages arranged in 8 – 18 longitudinal rows. The number of rows may decrease towards both ends of body, the appendages remain, however, of the same shape throughout the entire body. At most the outgrowths of the last annules on the posterior region may be a little modified. Head consisting of two annules narrower than subsequent body annules and devoid of appendages. Both head annules are generally of the same width, the first annule is only exceptionally wider than the second. Pseudolips with submedian lobes more or less developed. Spear 48 to 116 μ Vulva conical, closed, on the 5th – 19th annule from terminus; anterior vulval lip seldom longer than the posterior one. Posterior end of body conoid, pointed or more or less rounded.

Male is known only in a single species. Head flattened. Lateral field bearing 4 incisures. No bursa.

Young animals also possess scales on cuticle which are arranged in 8 – 16 longitudinal lines. It is a common phenomenon that the number of rows is greater on the larvae than on adults.

Mode of life: Definitely soil inhabiting nematodes living on plant roots.

Distribution (Fig. 6): Representatives of *Ogma* have been recorded hitherto from four continents: 5 species from Europe (*murrayi, octangulare, rhombosquamosum, spasskii, zernovi*), 9 species from Asia (*coffeae, decalineatum, fotedari, murrayi, octangulare, rhosimum, querci, simlaense, spinosum*), 5 species from Africa (*chrisbarnardi, decalineatum, lentiforme, octangulare, squamiferum*), 4 species from America (3 from North America: *decalineatum, murrayi, octangulare*, and 2 from South America: *decalineatum, duodevigintilineatum*). The three widest distributed species are *O. murrayi* (in 9 countries: Holland, England, Ireland, Austria, France, Yugoslavia, India, Java, United States), *O. octangulare* (in 8 countries: Austria, Germany, Poland, India, Ivory Coast, United States, Canada, Guadeloupe) and *O. decalineatum* (in 8 countries: India, Réunion*, Tanzania, Congo Republic, United States, Cuba, Paraguay, New Britain*). As for the number of species, the most representatives of the genus *Ogma* have been hitherto recorded from India (7 species: *coffeae, decalineatum, fotedari, murrayi, octangulare, simlaense* and *spinosum*) and from the United States (3 species: *decalineatum, murrayi, octangulare*).

* New records after specimens in my collection.

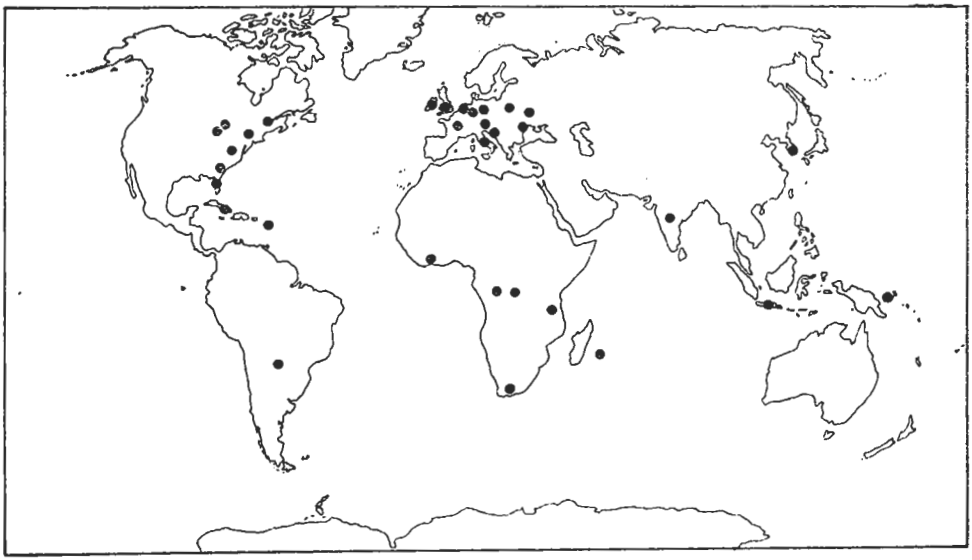


Fig. 6. Distribution of the genus *Ogma* SOUTHERN, 1914

Type species: *Ogma murrayi* SOUTHERN, 1914.
15 species:

O. chrisbarnardi (HEYNS, 1970) n. comb.
Syn. *Criconema chrisbarnardi* HEYNS, 1970
Crossonema (Seriespinula) chrisbarnardi (HEYNS, 1970) LOOF & DE GRISSE, 1973

O. coffeae (EDWARD, MISRA & RAI, 1970) n. comb.
Syn. *Criconema coffeae* EDWARD, MISRA & RAI, 1970

O. decalineatum (CHITWOOD, 1957) n. comb.
Syn. *Criconema decalineatum* CHITWOOD, 1957
Criconema (Varisquamata) decalineatum CHITWOOD, 1957 (MEHTA & RASKI, 1971)
Variasquamata decalineata (CHITWOOD, 1957) KHAN, CHAWLA & SAHA, 1976
Criconema (Variasquamata) gracile MEHTA & RASKI, 1971 (n. syn.)*
Variasquamata gracilis (MEHTA & RASKI, 1971) KHAN, CHAWLA & SAHA, 1976

O. duodevigintilineatum (ANDRÁSSY, 1968) n. comb.
Syn. *Criconema duodevigintilineatum* ANDRÁSSY, 1968
Criconema (Variasquamata) duodevigintilineatum ANDRÁSSY, 1968 (MEHTA & RASKI, 1971)
Variasquamata duodevigintilineata (ANDRÁSSY, 1968) KHAN CHAWLA & SAHA, 1976

* On the basis of the description *C. gracile* differs from *O. decalineatum* only by its smooth head annules. I think however, that this difference is too little to separate *gracile* from *decalineatum*. I have often observed within one and the same population of *decalineatum* specimens, some having finely crenate, others completely smooth head annules.

O. fotedari (MAHAJAN & BIJRAL, 1973) n. comb.
Syn. *Criconema (Variasquamata) fotedari* MAHAJAN & BIJRAL, 1973

O. lentiforme SCH. STEKHOVEN & TEUNISSEN, 1938
Syn. *Criconema lentiforme* (SCH. STEKHOVEN & TEUNISSEN, 1938) DE CONINCK, 1943
Criconema (Variasquamata) lentiforme (SCH. STEKHOVEN & TEUNISSEN, 1938) DE CONINCK, 1943 (MEHTA & RASKI, 1971)
Variasquamata lentiformis (SCH. STEKHOVEN & TEUNISSEN, 1938) KHAN, CHAWLA & SAHA, 1976
Ogma tripus SCH. STEKHOVEN & TEUNISSEN, 1938
Criconema tripus (SCH. STEKHOVEN & TEUNISSEN, 1938) DE CONINCK, 1945

O. murrayi SOUTHERN, 1914
Syn. *Criconema murrayi* (SOUTHERN, 1914) TAYLOR, 1936
Criconema (Variasquamata) murrayi (SOUTHERN, 1914) TAYLOR, 1936 (MEHTA & RASKI, 1971)
Variasquamata murrayi (SOUTHERN, 1914) KHAN, CHAWLA & SAHA, 1976
Hoplolaimus murrayi (SOUTHERN, 1914) MENZEL, 1917
Iota murrayi (SOUTHERN, 1914) MICOLETZKY, 1925

O. octangulare (COBB, 1914) SCH. STEKHOVEN & TEUNISSEN, 1938
Syn. *Iota octangulare* COBB, 1914
Hoplolaimus octangularis (COBB, 1914) MENZEL, 1917
Criconema octangulare (COBB, 1914) TAYLOR, 1936
Criconema (Variasquamata) octangulare (COBB, 1914) TAYLOR, 1936 (MEHTA & RASKI, 1971)
Variasquamata octangularis (COBB, 1914) KHAN, CHAWLA & SAHA, 1976
Criconema punici EDWARD, MISRA, PETER & RAI, 1971 (n. syn.)
Seriespinula punici (EDWARD, MISRA, PETER & RAI, 1971) KHAN, CHAWLA & SAHA, 1976

O. querci (CHOI & GERAERT, 1975) n. comb.
Syn. *Criconema (Variasquamata) querci* CHOI & GERAERT, 1975

O. rhombosquamatum (MEHTA & RASKI, 1971) n. comb.
Syn. *Criconema (Variasquamata) rhombosquamatum* MEHTA & RASKI, 1971
Variasquamata rhombosquamata (MEHTA & RASKI, 1971) KHAN, CHAWLA & SAHA, 1976

O. rhosimum (KHAN, CHAWLA & SAHA, 1976) n. comb.
Syn. *Variasquamata rhosima* KHAN, CHAWLA & SAHA, 1976

O. simlaense (JAIRAJPURI, 1963) n. comb.
Syn. *Criconema simlaense* JAIRAJPURI, 1963
Criconema (Variasquamata) simlaense JAIRAJPURI, 1963 (MEHTA & RASKI, 1971)
Variasquamata simlaensis (JAIRAJPURI, 1963) KHAN, CHAWLA & SAHA, 1976

O. spinosum n. sp.

O. squamiferum (HEYNS, 1970) n. comb.

Syn. *Lobocriconema squamiferum* HEYNS, 1970
Criconema squamiferum (HEBNS, 1970) LOOF & DE GRISSE, 1973

O. zernovi KIRJANOVA, 1948

Syn. *Criconema zernovi* (KIRJANOVA, 1948) CHITWOOD, 1957
Criconema (Variasquamata) zernovi (KIRJANOVA, 1948) CHITWOOD, 1957 (MEHTA & RASKI, 1971)
Variasquamata zernovi (KIRJANOVA, 1948) KHAN, CHAWLA & SAHA, 1976

Species inquirenda: *O. spasskii* (NESTEROV & LISETSKAYA, 1965) n. comb. – Syn. *Criconema spasskii* NESTEROV & LISETSKAYA, 1965.

Key to the species of Ogma

1 Cuticular appendages arranged in 16 – 18 rows. 2
– Cuticular appendages arranged in 8 – 12 rows. 3

2 Scales triangular; tail elongate-conoid, pointed with some smooth terminal annules. – L = 0.5 mm; V = 90%; R = 67; RV = 14; spear = 77 μ. ..... **duodevigintilineatum** (ANDRÁSSY)
– Scales blunt with smooth or crenate edge; tail stout with scaled annules. – L = 0.75 – 0.86 mm; V = 85 – 90%; R = 51 – 60; RV = 5 – 6; spear = 112 – 115 μ. ..... **querci** (CHOI & GERAERT)

3 Edge of scales crenate or waved, scales in 8 – 10 longitudinal rows. – L = 0.28 – 0.41 mm; R = 75 – 85; RV = 11 – 14; spear = 58 – 68 μ. ..... **coffeae** (EDWARD, MISRA & RAI)
– Edge of scales smooth, scales in 8, 10 or 12 longitudinal rows. 4

4 Scales in 8 rows. 5
– Scales in 10 or 12 rows. 8

5 First head annule distinctly wider than second; appendages on the poesterior body region longer than the foregoing ones and bifurcate; vulva on the 5th annule from terminus. – L = 0.35 mm; V = 92%; R = 59; RV = 5; spear = 72 μ. ..... **chrisbarnardi** (HEYNS)
– Both head annules of equal size; appendages on the posterior body region not strikingly longer than the foregoing ones and not bifurcate; vulva on the 7th – 15th annule. 6

6 Scales slender, much longer than wide, finely rounded or pointed; head annules crenate. – L = 0.42 – 0.51 mm; V = 83 – 87%; R = 68 – 75; RV = 14 – 15; spear = 78 – 84 μ. ..... **murrayi** SOUTHERN
– Scales wider than long and broadly rounded; head annules smooth. 7

7 Last 5 – 6 annules much narrower than the foregoing ones lending the tail an elongate shape. – L = 0.39 – 0.49 mm; V = 84 – 85%; R = 64 – 72; RV = 11 – 12; spear = 82 μ (?). **lentiforme** SCH. STEKHOVEN & TEUNISSEN
– Body end regularly conoid, tail not elongate. – L = 0.30 – 0.49 mm; V = 80 – 90%; R = 64 – 83; RV = 10 – 14; spear = 60 – 70 μ. ..... **octangulare** (COBB)

8 Vulva on the 7th – 10th annule from terminus; scales in 10 – 12 rows. 9
– Vulva on the 12th – 19th annule from terminus; scales in 10 rows. 11

9 Spear shorter, about 70 μ – L = 0.39 – 0.40 mm; V = 95 – 96%; R = 59 – 65; RV = 7 – 9; spear = 67 – 72 μ. ..... **rhosimum** (KHAN, CHAWLA & SAHA)
– Spear longer, 90 μ or more. 10

10 Body small, 0.4 mm; spear about 90 μ. – L = 0.39 mm; V = 85%; R = 66; RV = 9; spear = 92 μ. ..... **zernovi** KIRJANOVA
– Body longer, 0.6 – 0.7 mm; spear about 100 μ. – L = 0.62 – 0.70 mm; V = 88 – 90; R = 66 – 71; RV = 8 – 10; spear = 102 – 108 μ. ..... **squamiferum** (HEYNS)

11 Number of annules more than 70. 12
– Number of annules less than 70. 14

12 Vulva far ahead, on the 19th annule from terminus; posterior body end strongly elongate. – L = 0.57 mm; V = 84%; R = 86; RV = 19; spear = 80 μ. ..... **spinosum** n. sp.
– Vulva on the 12th – 15th annule from terminus; posterior body end not elongate. 13

13 Spear about 110 μ; tail with blunt terminus. – L = 0.33 – 0.40 mm; V = 85 – 90%; R = 74 – 83; RV = 13 – 15; spear = 107 – 116 μ. ..... **rhombosquamatum** (MEHTA & RASKI)
– Spear under 90 μ; tail with pointed terminus. – L = 0.35 – 0.54 mm; V = 84 – 88%; R = 75 – 86; RV = 13 – 15; spear = 61 – 85 μ. ..... **decalineatum** (CHITWOOD)

14 First head annule strikingly wider than second; vulva on the 12th – 13th annule from terminus. – L = 0.27 – 0.30 mm; V = 87 – 89%; R = 60 – 63; RV = 12 – 13; spear = 55 – 60 μ. **fotedari** (MAHAJAN & BIJRAL)
– Both head annules uniform; vulva on the 15th annule from terminus. – L = 0.36 – 0.50 mm; V = 82 – 85%; R = 65; RV = 15; spear = 68 μ. ..... **simlaense** (JAIRAJPURI)

Ogma spinosum n. sp.

(Fig. 7 A – B)

Holotype ♀: L = 0.57 mm; a = 12; b = 4.8; c = 9.2; V = 84%.

Body with 86 annules. On mid-body, annules 7 – 7.5 μ thick and 48 μ wide. They are ornamented by large, triangular scales arranged in 10 longitudinal rows. On the third annule only 6 scales are present, on the fourth and subsequent annules, however, already 10. Behind vulva the number of scales decreases again, the last appendages can be found on the 8th annule from terminus. Last 7 annules smooth or with small papilliform bumps. Distance between tips of scales of the same annule 14 – 15 μ.

Head of two annules with forward directed and finely waved margins. 1st annule 15 μ, 2nd 19 μ, 3rd 23 μ wide. Sublateral lobes present, well developed.

Spear 80 μ (14 annules) long, 14 per cent of total length of body. Basal knobs 7 μ wide; metenchium 85 per cent of spear length. Middle bulb distinctly longer than isthmus and terminal bulb together. 19 body annules between head and proximal end of oesophagus. Excretory pore on the 25th annule.

Vulva conical, closed, on the 68th annule from anterior end and on the 19th annule from terminus, respectively. Postvulval body portion 92 μ long. Anus on the 13th annule from terminus. Posterior end of body elongate-conoid, terminus pointed.

Male and larval forms unknown.

Holotype: ♀ on slide Nr. A – 7559 in the collection of the author.

Type habitat and locality: Moss from forest, 1600 m above sea level, Cherrapunji, Assam, India, collected in November, 1967 by Dr. GY. TOPÁL (Budapest).

Ogma spinosum n. sp. belongs to those members of the genus whose cuticle is ornamented by 10 longitudinal rows of scales. In the number of annules, length of spear and the crenate head annules it is most closely related to *O. decalineatum* (CHITWOOD, 1957), but differs from CHITWOOD' species and at the same time from all the other members of the genus by the strong, pointed scales, the elongate posterior end and the position of vulva (this latter lies on other *Ogma* species maximum on the 15th annule from terminus).

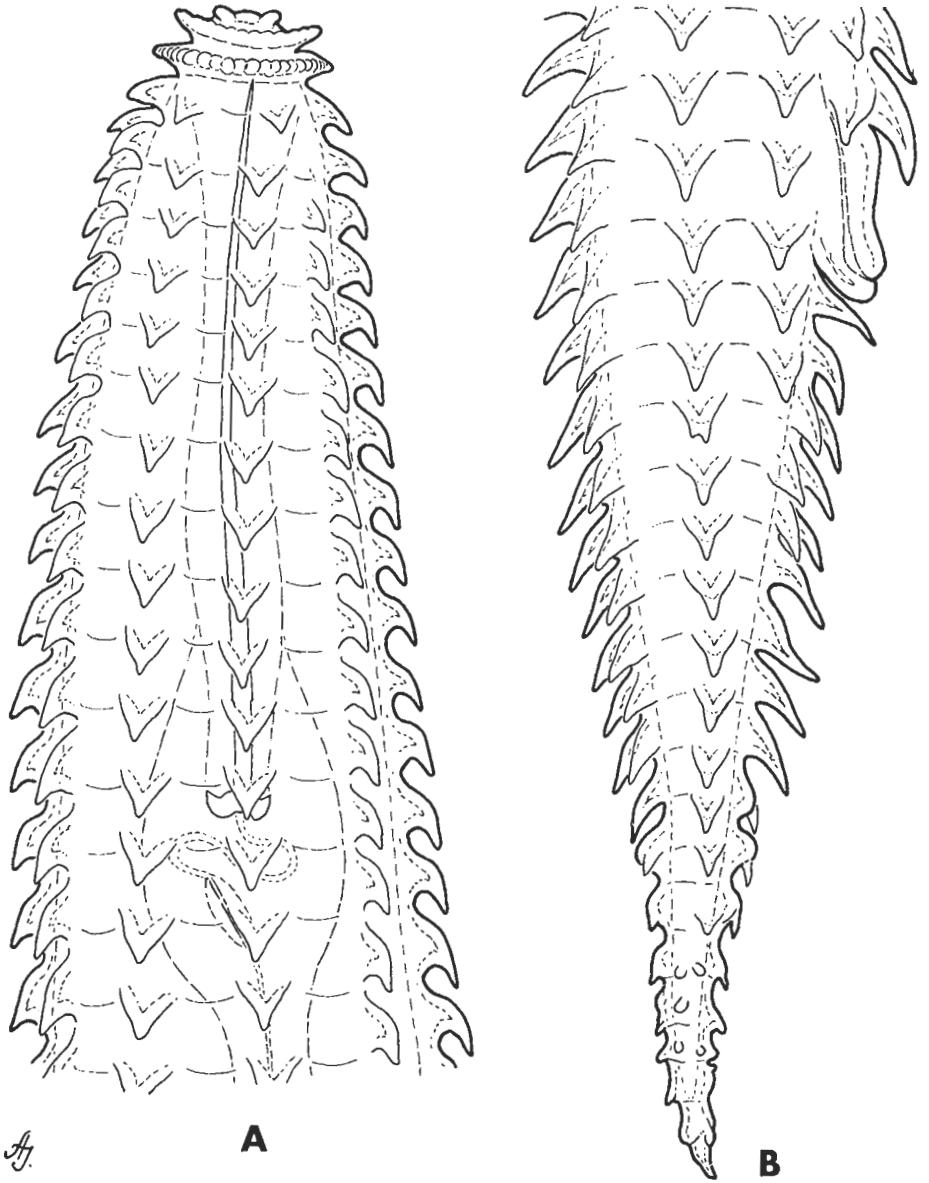


Fig. 7. *Ogma spinosum* n. sp. *A:* Anterior end (1250×); *B:* Posterior end (1250×)

Seriespinula (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976

Syn. *Crossonema* (*Seriespinula* Mehta & Raski, 1971).

Criconematinae. Body small to moderate (0.30 – 0.64 mm), stout. Cuticle with 44 – 90 annules drawn out posteriad. Annules ornamented by scales or spi-

Fig. 8. Distribution of the genus *Seriespinula* (MEHTA & RASKI, 1971) KHAN, CHAWLA & SAHA, 1976

nes arranged in 9 – 20 (exceptionally 27) longitudinal lines. All appendages or at least a great number of them bi- or multipointed (2 – 7 tipped). Some of the first annules not scaled but crenate or lobed, last body annules similar in ornamentation to the foregoing annules, except in one species. Head annules two, equally wide, smooth or rarely crenate or fringed. No submedian lobes. Length of spear between 63 and 125 μ. Vulva on the 6th to 15th annule from tail tip, with conical, closed lips. Posterior body end generally conoid, rarely blunt.

Male is known in a single species only. Lateral field marked by 3 incisures. Bursa very weakly developed.

Scales of young animals arranged in 10 – 18 longitudinal lines. The number of scale rows is either identical both on larvae and adults of the same species or less on larvae. The number of annules is, however, mostly greater on juveniles.

Mode of life: Generally terricolous animals but some of the species may occur on swampy fields, too.

Distribution (Fig. 8): Except the Antarctic *Seriespinula* species have been found on every continent: in Europe 2 species *(cobbi, hungarica)*, in Asia 4 species *(impar, octozonalis, sokliensis, tenuicaudata)*, in Africa 2 species *(coronata, hungarica)*, in North America 4 species *(cobbi, hungarica, seymouri, venusta)*, and in Australia 2 species *(cactus, melanesica)*. *Seriespinula* species have been recorded in greatest number from the United States (4 species: *cobbi, hungarica, seymouri, venusta)*. The widest distributed species is *S. cobbi* (in 10 countries: Holland, Belgium, Denmark, Austria, Hungary, Romania, France, Spain, Estonia, United States).

Type species: *Iota cobbi* MICOLETZKY, 1925 = *Seriespinula cobbi* (MICOLETZKY, 1925) KHAN, CHAWLA & SAHA, 1976.

11 species:

S. cactus n. sp.

S. cobbi (Micoletzky, 1925) Khan, Chawla & Saha, 1976
Syn. *Iota cobbi* Micoletzky, 1925
Criconema cobbi (Micoletpky, 1925) Taylor, 1936
Crossonema (Seriespinula) cobbi (Micoletzky, 1925) Mehta & Raski, 1971
Criconema cobbi duplex De Coninck, 1945
Criconema cobbi multiplex De Coninck, 1945
Criconema schuurmansstekhoveni De Coninck, 1943

S. coronata (Sch. Stekhoven & Teunissen, 1938) n. comb.
Syn. *Ogma coronatum* Sch. Stekhoven & Teunissen, 1938
Criconema coronatum (Sch. Stekhoven & Teunissen, 1938) De Coninck, 1943
Crossonema coronatum (Sch. Stekhoven & Teunissen, 1938) Mehta & Raski, 1971

S. hungarica (Andrássy, 1962) Khan, Chawla & Saha, 1976
Syn. *Criconema hungaricum* Andrássy, 1962
Crossonema (Seriespinula) hungaricum (Andrássy, 1962) Mehta & Raski, 1971

S. impar Khan, Chawla & Saha, 1976

S. melanesica n. sp.

S. octozonalis (Momota & Ohshima, 1974) Khan, Chawla & Saha, 1976*
Syn. *Crossonema (Seriespinula) octozonale* Momota & Ohshima, 1974

S. seymouri (Wu, 1965) Khan, Chawla & Saha, 1976
Syn. *Criconema seymouri* Wu, 1965
Crossonema (Seriespinula) seymouri (Wu, 1965) Mehta & Raski, 1971

S. sokliensis (Choi & Geraert, 1975) Khan, Chawla & Saha, 1976
Syn. *Crossonema (Seriespinula) sokliense* Choi & Geraert, 1975

S. tenuicaudata (Siddiqi, 1961) Khan, Chawla & Saha, 1976
Syn. *Criconema tenuicaudatum* Siddiqi, 1961
Crossonema (Seriespinula) tenuicaudatum (Siddiqi, 1961) Mehta & Raski, 1971

S. venusta (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
Syn. *Crossonema (Seriespinula) venustum* Mehta & Raski, 1971

The genus *Seriespinula* is closely related to *Ogma* Southern, 1914 and *Crossonema* Mehta & Raski, 1971. It can be distinguished *a)* from *Ogma:* submedian lobes absent and at most some of the cuticular spines bi- or multifurcate; *b)* from *Crossonema:* scales arranged in longitudinal rows, less in number on one annule and bi- or multipointed; scales of juveniles 10–18 at *Seriespinula* and generally 8 at *Crossonema.*

* Unfortunately I was not able to obtain the original description of this species, thus, I am not quite sure in its taxonomic position.

Key to the species of Seriespinula

1 Scales arranged in 16–20 longitudinal rows, on the posterior body region strongly modified, scattered by small papilliform elements; annules less than 50. – L = 0.44–0.64 mm; V = 90–92%; R = 44–49; RV = 6–8; spear = 82–92 μ. ..... **coronatum** (Sch. Stekhoven & Teunissen)

– Scales arranged in 9–16 longitudinal rows, on the posterior body region not modified strikingly, without "papillae"; annules 50 or more. 2

2 Annules 74–90. 3

– Annules 50–64. 4

3 Annules with triangular or semicircular scales packed by several thin and sharp spines; fine intermediate spines also between the scales; tail long drawn out; spear under 100 μ. – L = 0.44–0.58 mm; V = 88–90%; R = 74–81; RV = 11–15; spear = 89–94 μ. .. **cactus** n. sp.

– Annules with rounded spines arranged in groups of 2–4; no intermediate spines; tail not drawn out; spear well over 100 μ. – L = 0.42–0.60 mm; V = 86–89%; R = 76–90; RV = 10–15; spear = 111–125 μ. ..... **venusta** (Mehta & Raski)

4 Spear length under 80 μ. 5

– Spear length over 90 μ. 6

5 Vulva on the 8th annule from terminus; scales 5–6-tipped. – L = 0.29–0.35 mm; V = 85–86%; R = 57–60; RV = 8; spear = 70–71 μ. ..... **melanesica** n. sp.

– Vulva on the 13th annule from terminus; scales 2–3-tipped. – L = 0.45–0.47 mm; V = 85–87%; R = 63–64; RV = 13; spear = 63–65 μ. ..... **seymouri** (Wu)

6 Scales in 9 or 10 rows. 7

– Scales in 12, 14 or 16 rows. 8

7 First head annule distinctly wider than second and both smooth; scales bifurcate. – L = 0.40–0.46 mm; V = 83–85%; R = 50–60; RV = 11–12; spear = 109 μ. ..... **sokliensis** (Choi & Geraert)

– Both head annules of the same widths and waved; scales 2–5-furcate. – L = 0.35–0.55 mm; V = 82–87%; R = 52–63; RV = 10–14; spear = 95–111 μ. .. **hungarica** (Andrássy)

8 Scales in 12 rows. – L = 0.41–0.50 mm; V = 85–90%; R = 52–59; RV = 8–10; spear = 112–120 μ. ..... **impar** Khan, Chawla & Saha

– Scales in 14–16 rows. 9

9 Every scale furcate, 2–3- (or rarely 4-) pointed. – L = 0.43–0.49 mm; V = 86–88% R = 59–61; RV = 10–11; spear = 106–110 μ. ..... **tenuicaudata** (Siddiqi);

– Majority of scales simple, only some furcate, 2- or 3-pointed. – L = 0.32–0.52 mm; V = 80–85 %; R = 58–65; RV = 11–14; spear = 96–113 μ. ..... **cobbi** (Micoletzky)

Seriespinula melanesica n. sp.

(Fig. 9 A–D)

2 ♀: L = 0.29–0.35 mm; a = 8.0–8.7; b = 2.7–3.2; c = 12; V = 85–86%.

Body very small and plump, consisting of 57–60 annules. Annules drawn out posteriad, 5–7 μ thick and 36–41 μ wide on mid-body, ornamented by finger-shaped spines arranged in groups of 5–6 (rarely 4) and in 10 longitudinal rows, respectively. Spines 3–4 μ long and converging to one another in each group. They appear on the 3rd annule and are modified: on the posterior body region: strongly elongate.

Head of two annules, the first 6 μ high and 17–18 μ wide, the second 16 μ wide. Both with fringed margin. Oral field flattened, without submedian lobes. Third annule 22–23 μ wide.

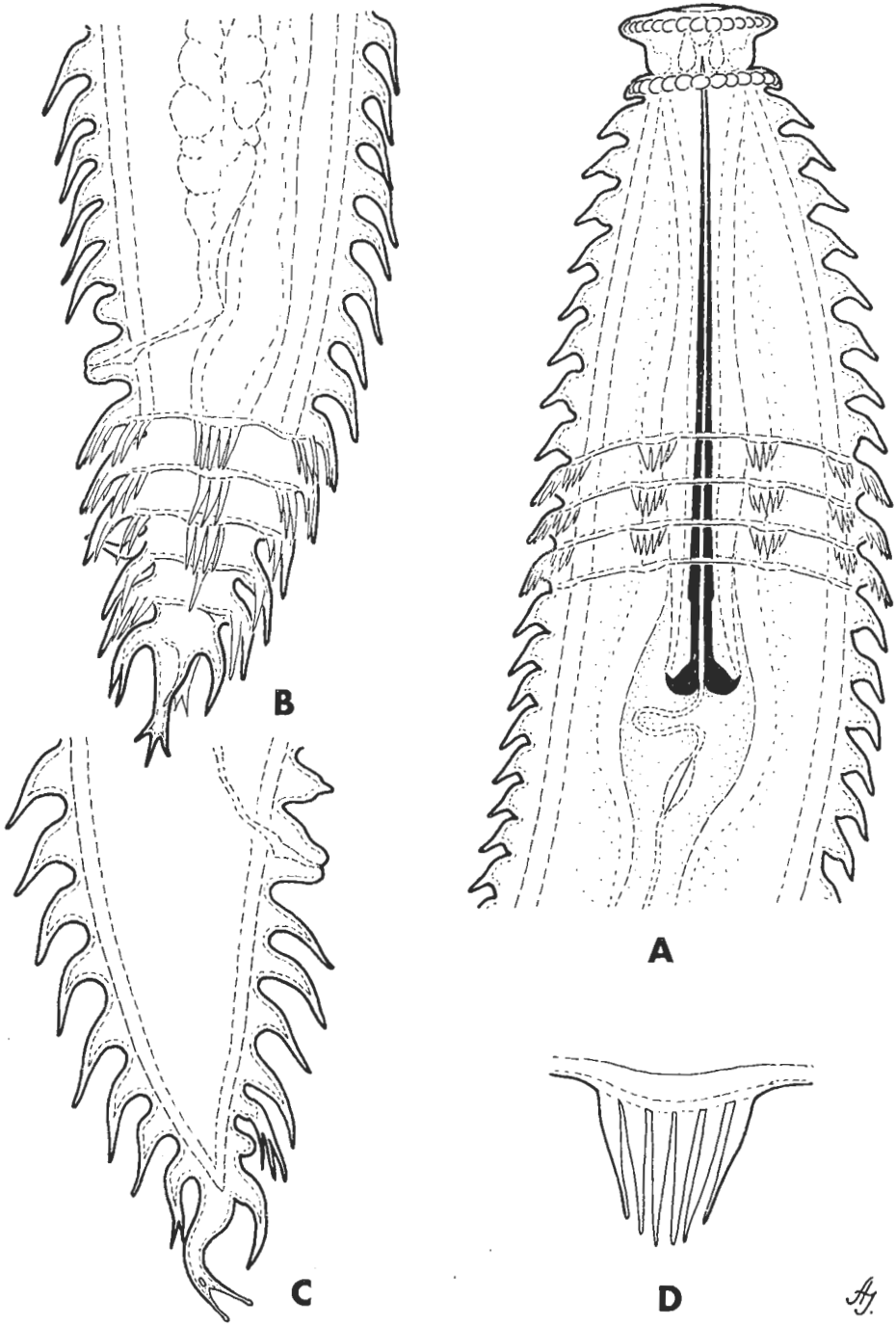


Fig. 9. *Seriespinula melanesica* n. sp. *A:* Anterior end (1250×); *B–C:* Posterior end, different females (1250×); *D:* A group of spines on mid-body

Spear 70 – 71 μ (16 – 17 annules) long, 20 – 24 per cent of the total body length. Basal knobs 8 – 9 μ wide; metenchium 83 – 84 per cent of the spear length. Proximal part of oesophagus slender, middle bulb a little shorter than isthmus and terminal bulb together. Distance between head and proximal end of oesophagus with 21 – 23 body annules. Excretory pore on the 19th-20th annule from the anterior end.

Vulva conoid, closed, on the 50th – 53rd annule from head and the 8th annule from terminus, respectively. Postvulval body portion 44 – 50 μ long. Anus inconspicuous, on the 4th annule from terminus. Tail conoid and pointed with elongate terminal annule (13 – 15 μ).

Male and larval forms unknown.

Holotype: ♀ on slide 8842 in the collection of the author. Paratype on the same slide.

Type habitat and locality: Humus from a three years old secondary rain forest, Macaranga, New Britain, collected in September, 1969 by Prof. Dr. J. BALOGH (Budapest) .

In shape of scales and the number of scale rows *Seriespinula melanesica* n. sp. resembles *S. hungarica* (ANDRÁSSY, 1962), *S. seymouri* (WU, 1965), *S. sokliensis* (CHOI & GERAERT, 1975), and *S. venusta* (MEHTA & RASKI, 1971). It differs *a)* from *hungarica:* head annules higher and fringed, spines more regular and longer, especially on the posterior body end, spear much shorter (95 – 111 μ at *hungarica)* vulva more to the back (on the 10th – 14th annule at *hungarica): b)* from *seymouri:* head of different shape and fringed, scale rows regular, 5 – 6 spines in a group, vulva more to the back (on the 13th annule at *seymouri): c)* from *sokliensis:* head annules fringed, scale rows 10 (9 at *sokliensis),* more spines in a group (generally only 2 at *sokliensis),* terminal spines elongate, spear far shorter (109 μ at *sokliensis),* vulva more to the back (on the 11th – 12th annule at *sokliensis*); *c)* from *venusta:* head annules fringed, scale groups with more members (mostly 3 spines in a group at *venusta),* body annules less in number (76 – 90 at *venusta),* spear much shorter (111 – 125 μ at *venusta),* terminal spines modified, vulva further back (on the 10th – 15th annule at *venusta).*

Seriespinula cactus n. sp.

(Fig. 10 A – C)

7 ♀: L = 0.44 – 0.58 mm; a = 8.2 – 11.5; b = 4.2 – 4.6; c = ?; V = 88 – 90%.

Holotype ♀: L = 0.56 mm; a = 10.8; b = 4.4; V = 90%; annules = 81; spear = 93 μ.

Body of medium size, stout. Cuticle with 74 – 81 annules. Annules 6.5 – 7.5 μ thick and 50 – 55 μ wide on the middle region of body. Scales triangular or semicircular, 3.5 – 4.5 μ long and packed by a number (6 – 10) of thin and sharply pointed "cactus" spines diverging radially. Scales becoming longer (8 – 12 μ) on the posterior body region and carrying spines in greater number (10 – 14) than the scales on mid-body. The scales appear on the third annule but are lacking on the terminal rings (these latter bear at most fine spines) and are arranged in 10 longitudinal rows. Fine and irregularly scattered intermediate spines may occur also on the margins of annules.

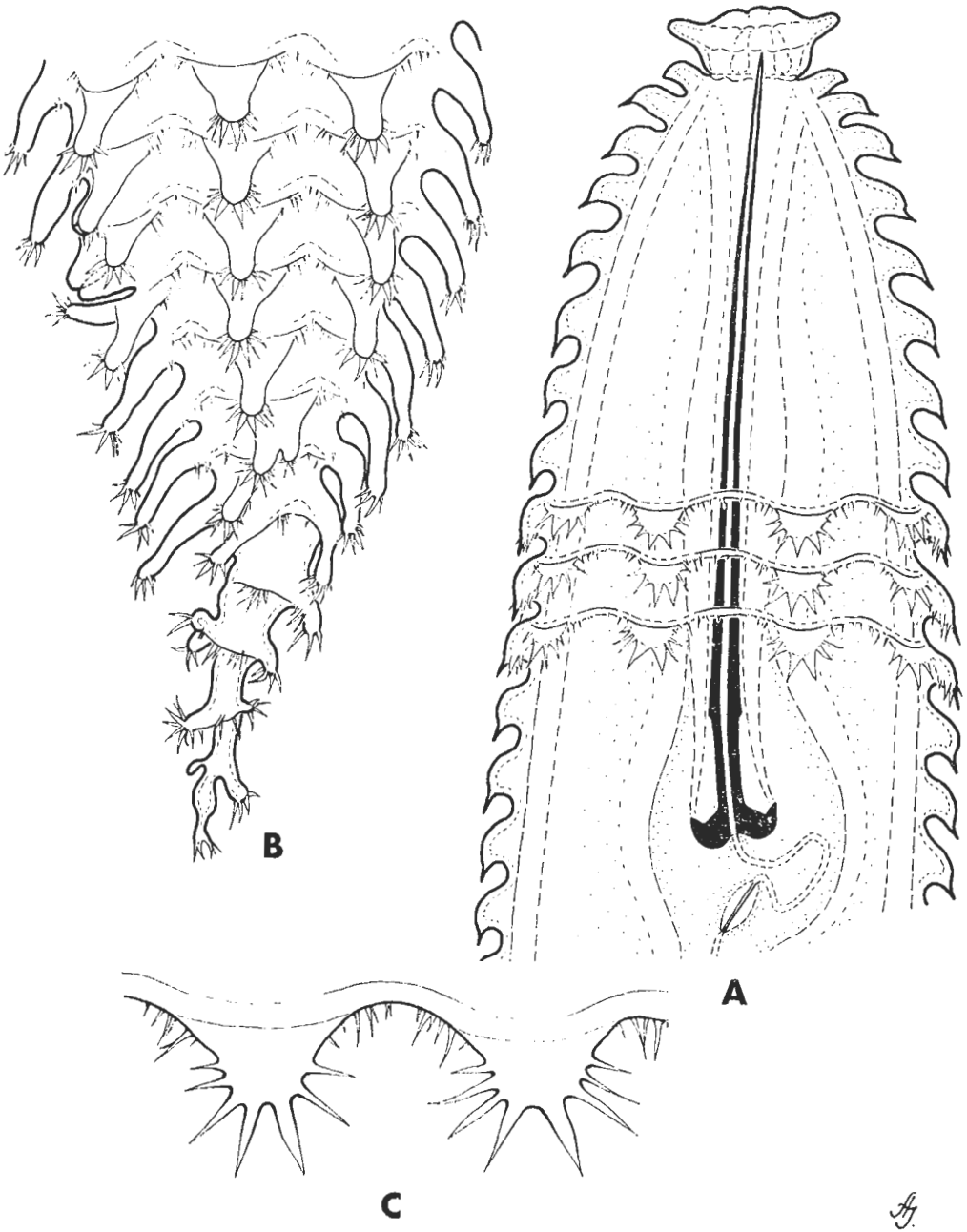


Fig. 10. *Seriespinula cactus* n. sp. *A:* Anterior end of body (1250×); *B:* Posterior end of body (1250× *C:* „Cactus" spines on mid-body

Head annules two with smooth or slightly waved edges. First annule a little narrower (18 – 23 μ) than second (19 – 25 μ). Third annule 26 – 32 μ wide. Oral field slightly convex; submedian lobes lacking.

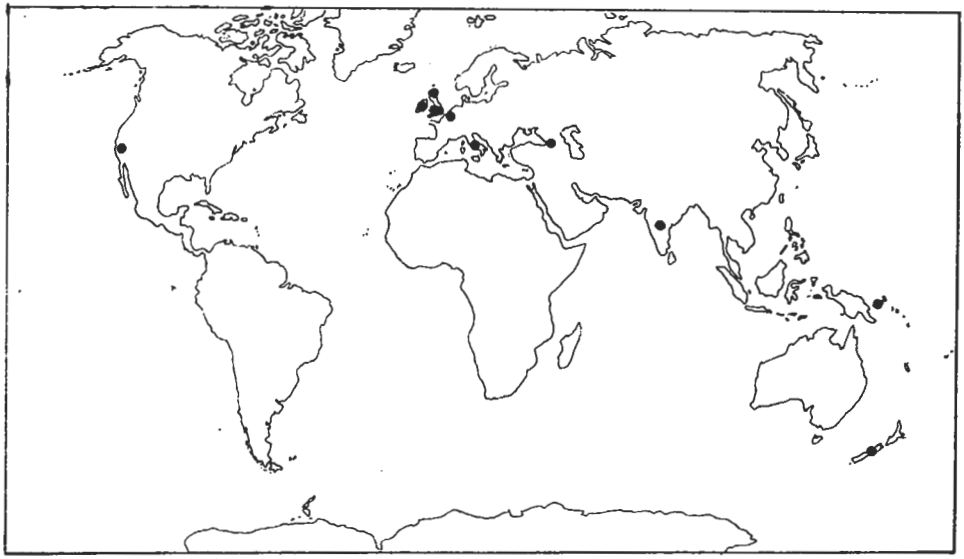


Fig. 11. Distribution of the genus *Croserinema* KHAN, CHAWLA & SAHA, 1976

Spear 89 – 94 μ (13 – 15 annules) long, 4 to 5 times longer than the first heap annule, 16 – 21 per cent of total body length. Basal knobs strong, 9 – 10 μ wide; metenchium 82 – 83 per cent of spear length. Median bulb as long as isthmus and terminal bulb together. Owing to the very heavy structure of cuticle, the exact position of the ecxretory pore and the anus could not be observed.

Vulva conoid, closed, on the 11th – 15th annule from tail tip. Vulval body diameter 35 – 39 μ, postvulval body portion 1.4 – 1.8 times longer than the former. Body end conoid, last 5 – 7 annules strongly drawn out with rudimentary scales but with fine spines.

Male and larvae not found.

Holotype ♀: on slide A – 6861. Holotype and 6 paratypes in the collection of the author.

Type habitat and locality: Virgin soil on the Marion Coral Reef off the Eastern coasts of Australia, collected in January, 1939 (!) by Dr. R. JEANNEL. (The specimens are presented to the author from the old collection of Dr. JEANNEL by the Speleological Institute, Cluj, Romania.)

Seriespinula cactus n. sp. can be separated from all the other species of the genus by its peculiar cuticular structure and the shape of tail. The shape of the cuticular appendages resembles somewhat that of *Croserinema palmatum* (SIDDIQI & SOUTHEY, 1962), but the spines are of different shape and more sharply pointed, and not arranged in alternating rows, the posterior end of body is long drawn out, etc.

Croserinema KHAN, CHAWLA & SAHA, 1976

Criconematinae. Body small (0.4 – 0.6 mm) and thick. Annules 45 – 60, each bearing generally 8 palmate lobes which alternate with those on adjacent annu-

les. Each appendage divided in 2 – 6 (mostly 4 – 5) finger-shaped spines. Beside these outgrowhts also scattered single spines may occur on annules. Head composed of two annules, of which the anterior annule wider than the posterior; both annules fringed on edge. Very small submedian lobes present. Spear 67 – 103 μ long. Vulva closed, on the 4th – 7th annule from terminus. Postvulval portion of body conoid-rounded.

Male unknown.

Cuticular ornamentation of larvae similar to that of females, in the rows of appendages, however, simple spines occur in greater number than palmate structures.

Mode of life: Soil inhabiting species, usually on roots of woody plants.

Distribution: The single species of the genus *Croserinema* is distributed on four continents: Europe (England, Scotland, Ireland, Belgium, Italy), Asia (Armenia, India), North America (United States) and Oceania (New Zealand, New Britain*).

Type species: *Criconema palmatum* SIDDIQI & SOUTHEY, 1962 = *Croserinema palmatum* (SIDDIQI & SOUTHEY, 1962) KHAN, CHAWLA & SAHA, 1976.

One species:

C. palmatum (SIDDIQI & SOUTHEY, 1962) KHAN, CHAWLA & SAHA, 1976

Syn. *Criconema palmatum* SIDDIQI & SOUTHEY, 1962

Crossonema palmatum (SIDDIQI & SOUTHEY, 1962) MEHTA & RASKI, 1971

Pateracephalanema MEHTA & RASKI, 1971

Criconematinae. Body small (0.23 – 0.50 mm) and very plump. Number of annules 55 – 98. Annules drawn out posteriad and often packed by incrusted soil or sand particles; thus, inner organisation can be therefore hardly observed. Annules ornamented by 8 – 16 longitudinally arranged rows of outgrowths; these are either smooth and broad or scale-like, digitiform or densely spined. Scales of the posterior end elongate, lobed or fringed. Head consisting of one or two annules, the first annule wide, somewhat saucer-shaped, well set off. Pseudolips simple, without submedian lobes. Spear not too long, 50 – 90 μ. Vulva open with flattened (only rarely conoid) lips, on the 7th – 8th annule from terminus. Tail blunt.

Males are known in two species. Lateral field marked by 4 incisures. Bursa present but narrow. Tail conoid-pointed.

We have only scanty information about the cuticle structure of the larvae.

Mode of life: Terricolous nematodes, in forest and cultivated soils.

Distribution: All the five species have been described hitherto from Australia (Fig. 12). It is possible that *Pateracephalanema* belongs to the very few known endemic taxa of Nematoda.

Type species: *Criconema imbricatum* COLBRAN, 1965 = *Pateracephalanema imbricatum* (COLBRAN, 1965) MEHTA & RASKI, 1971.

5 species:

* On the basis of specimens preserved in my collection; yet unpublished.

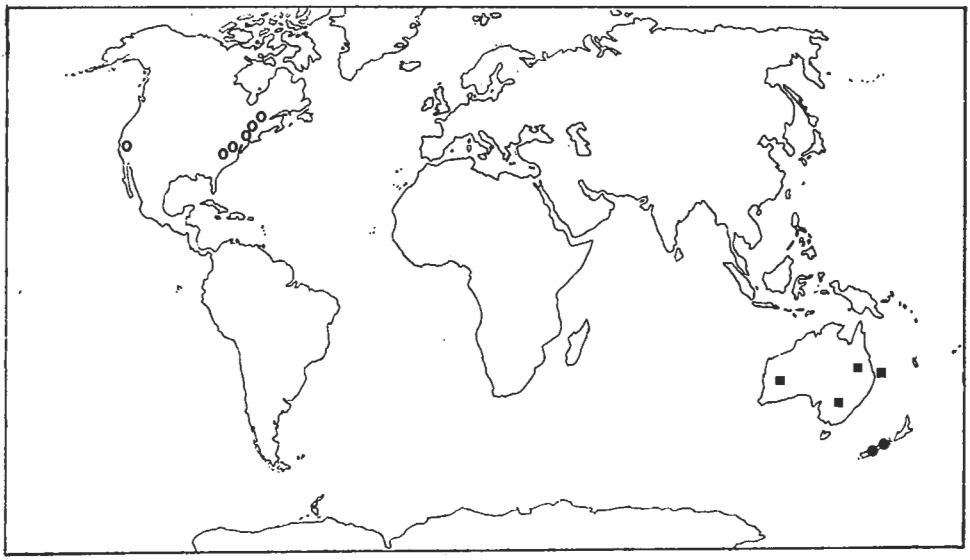


Fig. 12. Distribution of the genera *Bakernema* Wu, 1964 in North America (○), *Pateracephalanema* Mehta & Raski, 1971 in Australia (■) and *Blandicephalanema* Mehta & Raski, 1971 in New Zealand (●)

P. alticola (Colbran, 1965) Mehta & Raski, 1971
Syn. *Criconema alticola* Colbran, 1965

P. australe (Colbran, 1963) Mehta & Raski, 1971
Syn. *Criconema australe* Colbran, 1963

P. imbricatum (Colbran, 1965) Mehta & Raski, 1971
Syn. *Criconema imbricatum* Colbran, 1965

P. pellitum n. sp.

P. pectinatum (Colbran, 1962) Mehta & Raski, 1971
Syn. *Criconema pectinatum* Colbran, 1962

In the genus *Pateracephalanema* the cuticular appendages curved strongly backward and packed close to the body, the saucer-shaped offset head, the open vulva and the bluntly rounded terminus are characteristic features. Because of the very stout body and the blunt tail it seems to be closely allied with *Neolobocriconema* Mehta & Raski, 1971, from which it can be separated by the different structure of cuticle, the enlarged head annule, the greater number of annules (only 36 – 52 annules in *Neolobocriconema)*, the open vulva and by the lack of submedian lobes.

Key to the species of Pateracephalanema

1 Outgrowths of cuticle bearing spine- or finger-like projections; number of annules 55–65. 2
– Outgrowths of cuticle smooth, broad, scale-like; number of annules 70 – 98. 3

2 Cuticular protuberances arranged in 10 longitudinal rows, annules with continuous fringes of spines; head annule much wider than neck annule, spines of second annule directed forward; spear about 80 μ. – L = 0.46–0.50 mm; V = 91%; R = 55–60; RV = 7–8; spear = 84–89 μ. ..... **pellitum** n. sp.

– Cuticular protuberances arranged in 8 longitudinal rows, the digitiform appendages sitting on these protuberances only; head annule not or only slightly wider than neck annule, spines of second annule directed backward; spear 70 μ or less. – L = 0.3–0.39 mm; V = 89–93%; R = 55–65; RV = 7–8; spear = 64–70 μ. ..... **pectinatum** (COLBRAN)

3 Scales in 16 longitudinal rows; number of annules about 100. – L = 0.30–0.49 mm; V = 92–95%; R = 98; RV = 8; spear = 51–61 μ. ..... **alticola** (COLBRAN)

– Scales in 8 longitudinal rows; number of annules between 70 and 80. 4

4 Spear 68–80 μ long; scales semicircular. – L = 0.23–0.41 mm; V = 89–93%; R = 70–72; RV = 8; spear = 68–80 μ. ..... **imbricatum** (COLBRAN)

– Spear 50–56 μ long; scales angular. – L = 0.30–0.38 mm; V = 92–93%; R = 70–77; RV = 8; spear = 50–56 μ. ..... **australe** (COLBRAN)

Pateracephalanema pellitum n. sp.

(Fig. 13 A–B)

3 ♀: L = 0.46–0.50 mm; a = 8.5–9.3; b = 3.0–3.5; c = ?; V = 91%.

Body small and very robust, with 55–60 annules. Annules 7–8 μ thick in the middle region of body. Cuticle with 10 rows of longitudinal swellings. Each annule bearing a continuous fringe of 8–10 μ long, dense, comb-like spines; their exact number is difficult to state but each annule carry at least 150 spines.

Both first annules separated from the other with forward directed spines. Head annule 27–30 μ wide, fringed by a number of spines, second annule 21 μ wide with shorter spines.

Spear 84–89 μ long, 57–61 per cent of total length of oesophagus and 17–18 per cent of whole body length, respectively. Basal knobs 11–12 μ wide; metenchium 82–83 per cent of spear length. Median bulb as long as isthmus and terminal bulb together or somewhat shorter. 19–12 body annules from head to proximal end of oesophagus. Excretory pore not observable.

Vulva conoid, on the 7th or 8th annule from terminus. Posterior body portion stout with lobed-fringed annules.

Male and juveniles unknown.

Holotype ♀: on slide Nr. A–6520. Holotype and two paratypes in the collection of the author.

Type habitat and locality: Forest soil, in the vicinity of Perth, Western Australia, collected in September, 1970 by Prof. Dr. H. FRANZ (Wien).

Crossonema MEHTA & RASKI, 1971

Criconematinae. Body small to relatively long (0.3–0.8 mm), mostly robust. Annules 40–89 with backward curved margin. Each annule ornamented by a continuous row of dense bluntly rounded and uni-pointed spines or scales; they are not arranged in longitudinal rows, their number is between 24 and 90 on one annule on mid-body region. Spines of posterior body portion may be modified. Head annules two, exceptionally one, directed forward with smooth, waved

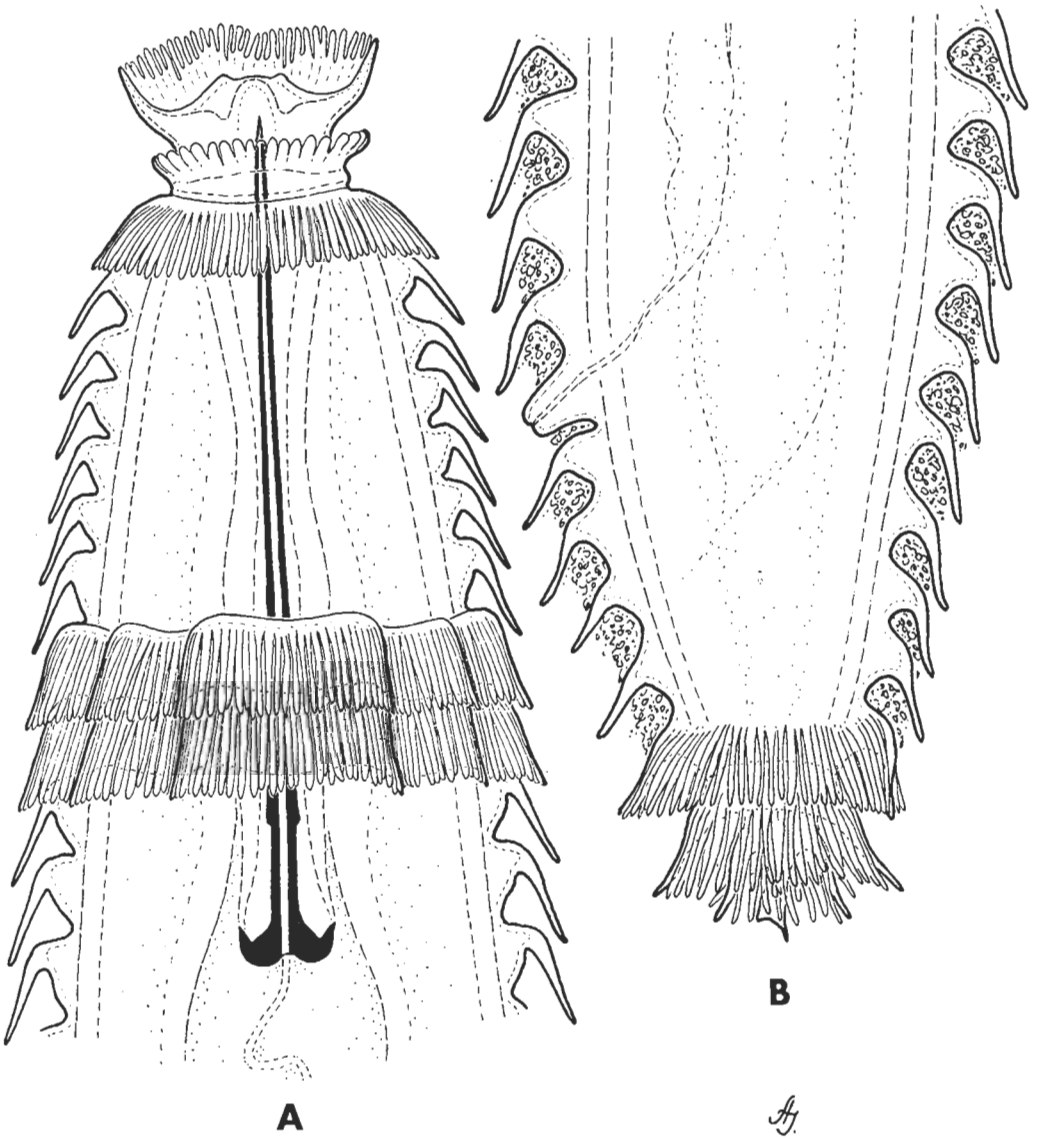


Fig. 13. *Pateracephalanema pellitum* n. sp. *A:* Anterior end (1250×); *B:* Posterior end (1250×)

or fringed edge. First head annule in almost every case strikingly wider than the second. No submedian lobes. Spear 69 – 130 μ long. Vulva closed, on the 3th to 16th annule from tail tip. Posterior end of body generally blount, rarely conoid-pointed.

Males of two species known hitherto. Lateral field marked by 4 incisures. Bursa present but very narrow, rudimentary.

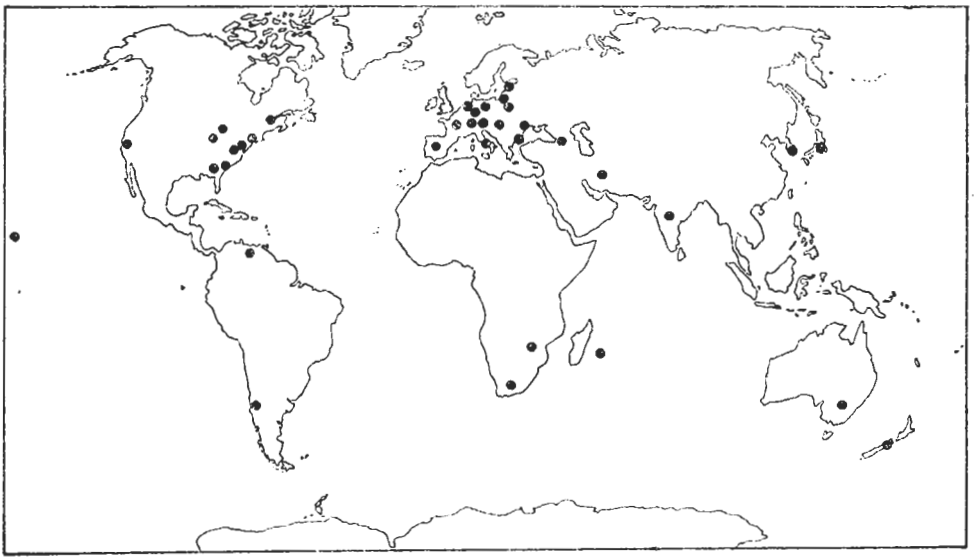


Fig. 14. Distribution of the genus *Crossonema* Mehta & Raski, 1971

Cuticle of larvae ornamented by scales arranged in 8 (exceptionally 9 – 10) rows. They differ in shape from those of adults: bifurcate, finger-like lobed or multi-spinose.

Mode of life: Most of the species live in the soil, on or near plant roots, some may occur, however, in swampy biotopes or *Sphagnum* moors.

Distribution: *Crossonema* species are distributed over the five continents (Fig. 13): 5 species in Europe *(aquitanense, boettgeri, fimbriatum, menzeli, multisquamatum)*, 7 species in Asia *(abies, fimcivatum, georgiense, menzeli, multisquamatum, taylatum, taylori)*, 1 species in Africa *(multisquamatum)*, 4 species in the Americas (4 in North America: *fimbriatum, menzeli, multisquamatum, proclive*, and 1 in South America: *multisquamatum)*, and 2 species in Australia *(latens, multisquamatum)*. Most of the species are recorded from the Soviet Union *(fimbriatum, georgiense, menzeli, multisquamatum)*, the United States *(fimbriatum, menzeli, multisquamatum, proclive)* and India *(fimcivatum, multisquamatum, taylatum, taylori)*. In Europe less than 50% of the hitherto described species occur. The most widely distributed representative of the genus *Crossonema* is *multisquamatum* which has been recorded up to now from 15 countries: Hungary, Spain, Georgia, India, Iran, Japan, Réunion*, Rhodesia, South Africa, United States, Canada, Venezuela, Chile*, Hawaii, Australia. An other wide distributed species is *C. menzeli*, it has been found in 13 countries: Holland, Germany, Austria, Hungary*, Poland, Switzerland, France, Latvia, Estonia, Bulgaria, Korea, United States, Canada.

Type species: *Criconema civellae* Steiner, 1949 = *Crossonema multisquamatum* (Kirjanova, 1948) Mehta & Raski, 1971 (n. syn.)

* New records after specimens in my collection.

11 species:

C. abies n. sp.

C. aquitanense (Fies, 1968) Mehta & Raski, 1971
Syn. *Criconema aquitanense* Fies, 1968

C. boettgeri (Meyl, 1954) n. comb.
Criconema boettgeri (Meyl, 1954) De Grisse & Loof, 1965

C. fimbriatum (Cobb in Taylor, 1936) Mehta & Raski, 1971
Syn. *Criconema fimbriatum* Cobb in Taylor, 1936

C. fimcivatum Khan, Chawla & Saha, 1976

C. latens Mehta & Raski, 1971

C. menzeli (Stefanski, 1924) Mehta & Raski, 1971
Syn. *Hoplolaimus menzeli* Stefanski, 1924
Iota menzeli (Stefanski, 1924) Micoletzky, 1925
Criconema menzeli (Stefanski, 1924) Taylor, 1936
Ogma menzeli (Stefanski, 1924) Sch. Stekhoven & Teunissen, 1938
Iota aculeatum Schneider, 1939 (n. syn.)
Criconema aculeatum (Schneider, 1939) De Conick, 1943
Crossonema aculeatum (Schneider, 1939) Mehta & Raski, 1971
Criconema guernei apud Menzel in Hofmänner & Menzel, 1914
Hoplolaimus guernei apud Schneider, 1923

C. multisquamatum (Kirjanova, 1948) Mehta & Raski, 1971
Syn. *Ogma multisquamatum* Kirjanova, 1948
Criconema multisquamatum (Kirjanova, 1948) Chitwood, 1957
Criconema civellae Steiner, 1949 (n. syn.)
Crossonema civellae (Steiner, 1949) Mehta & Raski, 1971
Criconema celetum Wu, 1960
Criconema eurysoma Golden & Friedman, 1964
Criconema vishwanatum Edward & Misra, 1966
Criconema fimbriatum apud Sveshnikova, 1940

C. proclive (Hoffmann, 1973) n. comb.
Syn. *Criconema proclive* Hoffmann, 1973

C. taylatum Khan, Chawla & Saha, 1976

C. taylori (Jairajpuri, 1964) Mehta & Raski, 1971
Syn. *Criconema taylori* Jairajpuri, 1964

Species inquirenda: *Crossonema georgiense* (Kirjanova, 1958) Ivanova, 1976 – Syn. *Criconema georgiense* Kirjanova, 1958.

Crossonema is most closely related to the genera *Ogma* Southern, 1914 and *Seriespinula* (Mehta & Raski, 1971) and can be distinguished from *a) Ogma* by the great number of scales not arranged in longitudinal rows, the lacking submedian lobes and that juveniles bear a less number of scales on each annule than mature specimens do; *b)* from *Seriespinula* by the great number of uni-tipped scales not arranged in longitudinal rows, the generally blunt tail terminus and the mostly 8 rows of scales on juveniles (10 – 18 rows at *Seriespinula*).

Key to the species of Crossonema

1 Annules less than 50; 70 – 90 spines on the annule on mid-body region*. 2
– Annules more than 50 (exceptionally less); 24 – 70 spines on one annule on mid-body region. 4

2 Vulva on the 3rd – 5th annule from tail tip; spines short. – L = 0.54 – 0.60 mm; V = 93 – 97%; R = 41 – 48; RV = 3 – 5; spear = 84 – 105 μ. ..... **fimcivatum** KHAN, CHAWLA & SAHA
– Vulva on the 6th – 8th annule from tail tip; spines long, digitiform. 3

3 Some scales on the posterior body end with lobes, 2-, 3- or multi-pointed; spines smooth. – L = 0.34 – 0.62 mm; V = 87 – 94%; R = 40 – 48; RV = 7 – 8; spear = 80 – 103 μ. ..... **multisquamatum** (KIRJANOVA)
– All scales on the posterior body end simple, uni-pointed; spines serrate. – L = 0.32 – 0.51 mm; V = 88 – 93%; R = 40 – 49; RV = 6 – 7; spear = 75 – 92 μ. ..... **boettgeri** (MEYL)

4 Annules on mid-body region bearing each 24 – 40 scales, some of them irregular on their end. 5
– Annules on mid-body region bearing each 40 – 70 scales, smooth on their ends. 6

5 Number of body annules 42 – 52; 30 – 40 scales on each annule. – L = 0.51 – 0.61 mm; V = 89 – 91%; R = 42 – 52; RV = 3 – 5; spear = 78 – 92 μ. ..... **taylatum** KHAN, CHAWLA & SAHA
– Number of body annules 56 – 57; 24 – 27 scales on each annule. – L = 0.44 – 0.48 mm; V = 91 – 94%; R = 56 – 57; RV = 7; spear = 81 – 82 μ. ..... **latens** MEHTA & RASKI

6 Number of annules above 80. – L = 0.44 – 0.69 mm; V = 82 – 95%; R = 84 – 93; RV = 12 – 16; spear = 101 – 120 μ. ..... **aquitanense** (FIES)
– Number of annules under 80. 7

7 Scales short, as long as wide, 30 – 40 on one annule, on the terminal annules widened, bifurcate; vulva far back, on the 4th – 6th annule from tail tip. – L = 0.46 – 0.56 mm; V = 92 – 94%; 53 – 58; RV = 4 – 6; spear = 80 – 85 μ. ..... **taylori** (JAIRAJPURI)
– Scales long and narrow, 40 – 70 on one annule, on the terminal annules not modified; vulva more forward, on the 10th – 16th annule from tail tip. 8

8 First head annule with long spine-like lobes. 9
– First head annule smooth or only finely crenate. 10

9 Only one head annule directed forward; cuticular spines fir-needle-like, each with two fine longitudinal lines, last body annules spineless. – L = 0.45 mm; V = 80%; R = 68; RV = 16; spear = 102 μ. ..... **abies** n. sp.
– Two head annules directed forward; cuticular spines simple, without longitudinal lines, last body annules also bearing spines. – L = 0.30 – 0.60 mm; V = 80 – 90%; R = 53 – 70 (mostly 60 – 70); RV = 10 – 14; spear = 90 – 103 μ. ..... **menzeli** (STEFANSKI)

10 Annules 53 – 63; spear longer than 90 μ. – L = 0.40 – 0.80 mm; V = 84 – 87%; R = 53 – 63; RV = 10 – 11; spear = 95 – 96 μ. ..... **fimbriatum** (COBB in TAYLOR)
– Annules 67 – 74; spear shorter than 90 μ. – L = 0.30 – 0.41 mm; V = 84 – 87%; R = 67 – 74; RV = 12 – 13; spear = 69 – 81 μ. ..... **proclive** (HOFFMANN)

Crossonema abies n. sp.

(Fig. 15 A – C)

Holotype ♀: L = 0.45 mm; a = 7.5; b = 3.1; c = ?; V = 80%.

Number of body annules 68. Annules 7 – 8 μ thick and 60 μ wide on the middle region of body, each packed with a fringe of about 50 fir-needle-shaped

* In the description of *C. fimcivatum*, Khan, Chawla and Saha speak about "more than 130 reduced spines" on one annule, the Fig. 7 *C* however illustrates only 87 spines on the mid-body cross section.

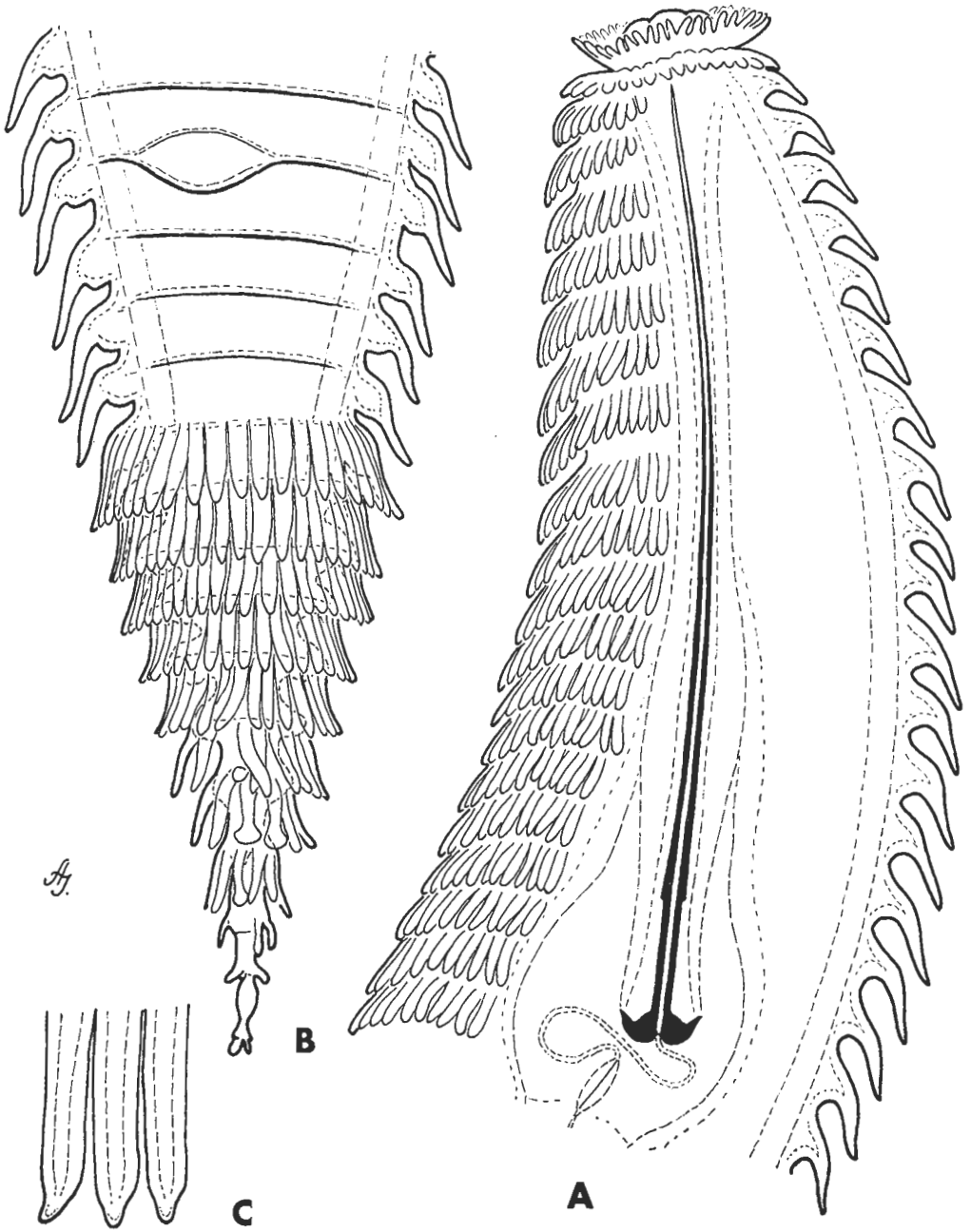


Fig. 15. *Crossonema abies* n. sp. *A:* Anterior region (1250×); *B:* Posterior end of body (1250×); *C:* Fir-tree needle-like spines on mid-body

spines. They are 8–9 μ long and peculiarly similar to the neledes of a fir-tree (*Abies alba* Mill.) since they also have two fine longitudinal lines like fir-needles on the back sied. (Hence the specific name "*abies*".) The spines begin on the first annule and they become gradually shorter or rudimentary on the last body annules only.

Head consisting of one annule since the second annule is directed backward. Head annule 20 μ, second annule 22 μ and third annule 27 μ wide. Head annule carrying about 20 spines. No submedian lobes.

Spear 102 μ (19 annules) long, 23 per cent of total length of body. Basal knobs 8 μ wide. Middle bulb about as long as isthmus and terminal bulb together. On the oesophageal region (between head and proximal end of oesophagus) 25 body annules can be counted. Excretory pore on the 20th annule from head end at level with the median bulb.

Vulva conoid, closed, on the 53rd annule from head and on the 16th annule from terminus. Postvulval body portion 88 μ long. Posterior end of body elongate-conoid with pointed terminus. Last 4 annules longer than wide, especially the two terminal rings very thin.

Male and larval forms not observed.

Holotype ♀: on slide Nr. 8257 in the collection of the author.

Type habitat and locality: Soil from an *Abies-Tsuga-Betula*-forest, 2000–2400 m above sea level, Mt. Yokodake, Nagamo Prefecture, Japan, collected in June, 1974 by Prof. Dr. H. FRANZ (Wien).

Crossonema abies n. sp. is very similar to *C. menzeli* (STEFANSKI, 1924), it can however be distinguished from the latter species by the one-annuled head, the somewhat thicker spines ornamented by two longitudinal lines, the position of vulva (on the 10–14th annule at *menzeli*), the more elongate posterior body region and the naked terminal annules.

Blandicephalanema MEHTA & RASKI, 1971

Criconematinae. Body small (0.36–0.56 mm) and robust. Annules 70–80, drawn out posteriad, ornamented by appendages arranged in 8 or 28 rows. Scales with broad basis and spine-like tip. Between the scales the margings of annules can be serrate. Scales not modified on posterior body end. Head narrow, with one annule bearing a convex oral region. No submedian lobes. Spear 63–90 μ long. Vulva on the 8th–11th annule from terminus, closed with conoid lips. Tail conoid.

Male marked by three incisures on the lateral field. Spicules longer than tail, bursa very narrow, rudimentary.

On the cuticle of larvae there are 10 longitudinal rows of short scales.

Mode of life: Soil inhabiting nematodes.

Distribution (Fig. 12): Both species, known hitherto, live in New Zealand (an endemic group?).

Type species: *Blandicephalanema serratuma* MEHTA & RASKI, 1971.

Two species:

B. pilatum Mehta & Raski, 1971

B. serratum Mehta & Raski, 1971

Blandicephalanema can be distinguished from all the other genera of Criconematinae by the unusual shape of head.

Key to the species of Blandicephalanema

1 Scales arranged in 8 longitudinal rows; spear shorter than 70 μ. – L = 0.36–0.56 mm; V = 87–89%; R = 70–85; RV = 10–11; spear = 63–67 μ. ..... **serratum** Mehta & Raski
– Scales arranged in 28 longitudinal rows; spear longer than 80 μ. – L = 0.40–0.49 mm; V = 89–92%; R = 75–88; RV = 8–9; spear = 84–90 μ. ..... **pilatum** Mehta & Raski

Bakernema Wu, 1964

Criconematinae. Body moderate to large (0.5–1.0 mm). Annules 61–108 with rounded outline. Cuticle bearing thin, transparent, membraneous outgrowths not arranged in definite longitudinal rows. Appendages on posterior body region generally enlarged. Head with one annule, not set off, ornamented also by membraneous outgrowhts. Submedian lobes weakly developed or lacking. Spear 64–142 μ long. Vulva on the 5th–10th annule from terminus. Tail blunt.

Lateral field of male marked by 4 incisures. Bursa present but rudimentary.

The cuticular structure of larvae is similar to that of adults, the appendages are, however, heavier, cuticularized and not arranged in definite longitudinal rows.

Mode of life: Terricolous nematodes.

Distribution: According to the present status the genus *Bakernema* occur only in North America (Fig. 12). Perhaps, similarly to *Pateracephalanema* and *Blandicephalanema*, the species of this genus inhabit a single continent.

Type species: *Criconema bakeri* Wu, 1964 = *Bakernema inaquale* (Taylor, 1936) Mehta & Raski, 1971.

Two species:

B. inaequale (Taylor, 1936) Mehta & Raski, 1971
Syn. *Criconema inaequale* Taylor, 1936
Criconema bakeri Wu, 1964
Bakernema bakeri (Wu, 1964) Wu, 1964

B. variabile Raski & Golden, 1966

The genus *Bakernema* differs from the other genera of the subfamily by the fine, transparent outgrowths of cuticle, the differentiated head and by the fact that the appendages of the larval cuticle are not arranged in definite longitudinal rows.

Key to the species of Bakernema

1 Membraneous outgrowths of cuticle relatively large, scale-like; spear less than 80 μ; anterior lip of vulva overhanging. – L = 0.42–0.56 mm; V = 91–94%; R = 63–70; RV = 5–6; spear = 64–72 μ. ..... **inaequale** (TAYLOR)

– Membraneous outgrowths of cuticle small, lace-like; spear more than 90 μ; anterior lip of vulva not overhanging. – L = 0.53–0.99 mm; V = 89–95%; R = 92–107; RV = 6–10; spear = 97–142 μ. ..... **variabile** RASKI & GOLDEN

REFERENCES

Owing to the limited extent of the present article, the list of literature is restricted to those papers which have not been included in the references of the *Criconema* revision of MEHTA and RASKI (1971).

1. ADAMS, R. E. & LAPP, N. A. (1967): *Criconemoides grassator n. sp. from yellow poplar (Liriodendron tulipifera) in West Virginia.* – Nematologica, 13: 63–66.

2. ANDRÁSSY, I. (1952): *Freilebende Nematoden aus dem Bükk-Gebirge.* – Ann. Hist.-nat. Mus. Nat. Hung., 2: 13–65.

3. ANDRÁSSY, I. (1963): *The zoological results of Gy. Topál's collectings in South Argentina. 2. Nematoda. Neue und einige seltene Nematoden-Arten aus Argentinien.* – Ann. Hist.-nat. Mus Nat. Hung., 55: 243–273.

4. ANDRÁSSY, I. (1965): *Verzeichnis und Bestimmungsschlüssel der Arten der Nematoden-Gattungen Criconemoides Taylor, 1936 und Mesocriconema n. gen.* – Opusc. Zool. Budapest, 5: 153–171.

5. ANDRÁSSY, I. (1967): *Nematoden aus Chile, Argentinien und Brasilien, gesammelt von Dr. H. Franz.* – Opusc. Zool. Budapest, 7: 3–34.

6. BOONDUANG, A. & RATANAPRAPA, D. (1974): *Identification of plant parasitic nematodes of Thailand. Systemic study of Criconematidae in Thailand with descriptions of three new species.* – Plant Prot. Serv. Techn. Bull. Bangkok, 22: 1–16.

7. CHOI, Y. E. & GERAERT, E. (1975): *Criconematids from Korea with description of eight new species (Nematoda: Tylenchida).* – Nematologica, 21: 35–52.

8. COBB, N. A. (1924): *Iota crotaloides n. sp. and the amphids of the triplonchs.* – Journ. Parasitol. 11: 102.

9. DIAB, K. A. & JENKINS, W. R. (1965): *Description of Neocriconema adamsi n. gen., n. sp. (Criconematidae: Nematoda) with a key of Neocriconema.* – Proc. Helminthol. Soc. Washington, 32: 193–197.

10. DIAB, K. A. & JENKINS, W. R. (1966): *Three new species of Criconemoides (Nematoda: Criconematidae).* – Proc. Helminthol. Soc. Washington, 33:: 5–7.

11. EDWARD, J. C. & MISRA, S. L. (1964): *Criconemoides magnoliae n. sp. and C. juniperi n. sp. (Nematoda: Criconematidae) from Kumaon region, Uttar Pradesh, India.* – Nematologica, 10: 95–100.

12. EDWARD, J. C., MISRA, S. L. & RAI, B. B. (1970): *Criconema coffeae n. sp. associated with the roots of coffee in Mysore State, India.* – Allahabad Fmr, 44: 13–15.

13. EDWARD, J. C., MISRA, S. L., PETER, E. & RAI, B. B. (1971): *A new species of Criconema associated with pome-granate (Punica granatum L.).* – Indian Journ. Nematol., 1: 59–62.

14. GOODEY, J. B. (Goodey, T.) (1963): *Soil and freshwater nematodes.* – London, 544 pp.

15. GREEFF, R. (1869): *Untersuchungen über einige merkwürdige Thiergruppen des Arthropoden- und Wurm-Typus.* – Arch. Naturgesch., 35: 71–121.

16. DE GRISSE, A. (1967): *Description of fourteen new species of Criconematidae with remarks on different species of this family.* – Biol. Jaarb., 35: 66–125.

17. De Guiran, G. (1963): *Quatre espèces nouvelles du genre Criconemoides (Taylor) (Nematoda – Criconematidae).* – Rev. Path. Veg. Ent. Agric. France, 42: 1 – 11.

18. Gunhold, P. (1953): *Drei neue Nematoden aus den Ostalpen.* – Zool. Anz., 150: 35 – 38.

19. Heyns, J. (1970): *South African Criconematinae. Part I. Genera Nothocriconema, Lobocriconema Criconemella, Xenocriconemella, and Discocriconemella (Nematoda).* – Phytophylactica, 2: 49 – 56.

20. Heyns, J. (1970): *South African Criconematinae. Part II. Genera Criconema, Hemicriconemoides, and some Macroposthonia (Nematoda).* – Phytophylactica, 2: 129 – 136.

21. Hoffmann, J. K. (1973): *Criconema proclivis n. sp. (Nematoda: Criconematinae) from woodlands.* – Journ. Nematol., 5: 155 – 157.

22. Ivanova, T. S. (1976): *Paraziticheskie kornevye nematody. Semejstvo Criconematidae.* – Leningrad: 1 – 178.

23. Jairajpuri, M. S. & Siddiqi, A. H. (1963): *On three new species of the genus Criconemoides Taylor, 1936 (Nematoda: Criconematidae) from North India.* – Zeitschr. Parasitenk., 23: 340 – 347.

24. Khan, E., Chawla, M. L. & Saha, M. (1976): *Criconematoidea (Nematoda: Tylenchida) from India, with descriptions of nine new species, two new genera and a family.* – Indian Journ. Nematol., 5: 70 – 100.

25. Khan, E. & Nanjappa, C. K. (1973): *Four new species of Criconematoidea (Nematoda) from India.* – Indian. Journ. Nematol., 2: 59 – 68.

26. Khan, S. H. (1964): *Criconemoides siddiqii n. sp. (Nematoda: Criconematidae) from North India.* – Zool. Anz., 173: 342 – 344.

27. Khan, E. & Siddiqi, M. R. (1964): *Criconema laterale n. sp. (Nematoda: Criconematidae) from Srinagar, Kashmir.* – Nematologica, 9: 584 – 586.

28. Kirjanova, E. S. (1958): *Worms – Vermes. Round worms – plant pathogenic and soil nematodes – Nematodes.* (Russian text.) – In: Animal communities of the USSR, Moscow, 477 – 485.

29. Krnjaic, D. & Loof, P. A. A. (1973): *Description of Nothocriconema psammophilum n. sp. (Nematoda: Criconematoidea) with some data on its ecology.* – Meded. Fakult. Landbouwwet. Gent, 38: 73 – 76.

30. Maas, P. W. Th., Loof, P. A. A. & De Grisse, A. (1971): *Nothocriconemoides lineolatus (n. gen., n. sp. Nematoda: Criconematidae).* – Meded. Fakult. Landbouwwet., Gent, 36: 711 – 715.

31. Mahajan, R. & Bijral, S. S. (1973): *Studies on the Criconematidae (Nematoda: Tylenchida) from India, with the description of two new species.* – Zool. Anz., 191: 199 – 205.

32. De Man, J. G. (1921): *Nouvelles recherches sur les Nematodes libres terricoles de la Hollande.* – Capita Zool., 1: 3 – 62.

33. Mehta, U. K. & Raski, D. J. (1971): *Revision of the genus Criconema Hofmänner and Menzel, 1914 and other related genera (Criconematidae: Nematoda).* – Indian Journ. Nematol., 1: 145 – 198.

34. Momota, Y. & Ohshima, Y. (1974): *Crossonema octozonale n. sp., on Japanese cedar from Japan.* – Japan. Journ. Nematol., 4: 47 – 50.

35. Raski, D. J. & Pinochet, J. (1976): *Descriptions of four new species of Nothocriconema and the male of N. sphagni (Criconematidae: Nematoda).* – Nematologica, 22: 265 – 276.

36. Raski, D. J. & Pinochet, J. (1976): *Merocriconema braziliensis g. n., sp. n. (Criconematidae: Nematoda) from Piper sp.* – Indian Journ. Nematol., 5: 22 – 25.

37. Skarbilovich, T. (1959): *On the structure of systematics of nematodes order Tylenchida Thorne, 1949.* – Acta Parasit. Polon., 7: 117 – 132.

Opusc. Zool. Budapest, XVI, 1–2, 1979

Contribution to the Knowledge on the Invertebrate Macrofauna Living in the Pondweed Fields of Lake Fertő

By

S. Andrikovics*

Abstract. Founded on two years of collection at monthly frequency, the author demonstrated 73 taxa of the macrofauna from the pondweed habitats of Lake Fertő. Relying upon the character of the macrofauna, he compares the fauna associations of the open water with those of the isolated pondweed fields. Within the possibilities afforded by the adopted collecting method, he also makes some mass-dynamical and synbiological observations. The lack of natronophilous forms, as well as the great number of species of wide tolerance in the animal groups support the astatic character of Lake Fertő in zoological respect.

In hydro-ecological respect the pondweed fields of Lake Fertő take an intermediate place between reeds and open water. The invertebrate macrofauna connecting to them is advantageously influenced by the generally favourable water climate and by the abundance of the base. It is unfavourable, on the other hand, that in Lake Fertő they are, as a rule but unstable formations.

According to our knowledge up to now, invertebrate macrofauna is affected in the first by the location, size, density and dominant species of the pondweed stands (1, 4). In Lake Fertő, this effect is manifested in the first place in quantitative respect (1).

By the term invertebrate macrofauna the organisms belonging to an order of magnitude of about 0.2 – 20 mm are meant, of which the majority is classified among the aquatic insects and their larvae. Besides the elaboration of these, also considering special Fertő respects, the author set himself the aim of determining the frequently occurring species of the groups of Hirudinoidea, Gastropoda and Hydracarina.

In view of the generally known taxonomic difficulties of zoological examinations covering several animal groups and performed by non-specialists, the author could only strive for surveying the frequently occurring species. He also intends

Dr. Sándor Andrikovics, ELTE Állatrendszertani és Ökológiai Tanszék (Zoosystematical and Ecological Institute of the Eötvös Loránd University), 1088 Budapest VIII. Puskin u. 3.

to develop the examinations by further detailed studies (raising larvae, imago examinations) of the animal groups of major importance.

The place, date and method of sampling

The constant sampling areas were the pondweed fields of the Rákos flat in front of the reed screen, the lakes Herlakni, Hidegség and Überfart. The author often collected, besides, in the area of the Madárvárta-, Hegykő- and Rucás-inlets. The examinations were conducted in 1971—72, during the vegetation period, as a rule from May to October with monthly frequency. In 1971, the dates of collection were: May 27th, June 29th, July 28th, August 23rd, September 14th and October 27th. In 1972, the zoological collections were done on May 5th, June 2nd, July 11th, August 23rd, September 19th and October 26th. In the examinations the author adopted the so-called approximating quantitative collceting method. The results he indicated with the frequency numbers 1, 2, 3 and 4. The figures, meaning 1 = few, 2 = medium, 3 = many, 4 = in large numbers, stand for the relative quantities verying with the animal groups.

The results of the examinations and their evaluation

Founded on the elaboration of the material of the two years' systematic zoological collection, the author could demonstrate 7 Hirudinoidea, 9 Gastropoda, 1 Isopoda, 4 Ephemeroptera, 10 Odonata, 12 Trichoptera, 2 Lepidoptera, 4 Coleoptera, 8 Heteroptera and 15 Hydracarina taxa. A detailed enumeration of the species is presented in Tables 1, 2, 3 and 4. To the demonstrated 73 taxa even at this order of magnitude the vast quantity of Diptera larvae is added, the detailed elaboration of which the author could not even undertake.

In the groups examined by the author, the organisms which turned up were all species of wide ecological valency. Up to the present he did not find natronophilic forms.

In agreement with the zoological examinations conducted in the pondweed fields of Lake Balaton or in those of the lakes of eastern Holstein (2, 4) also the fact appeared that in the surveyed animal groups the demonstration of an animal species living in merely one pondweed field could not be expected either. Therefore, the author did not separately indicate the pondweed species in the Tables.

The macrofauna of the open-water pondweed fields is relatively poor, probably on account of the rather unfavourable conditions of population and of intensive wind action. In open-water *Potamogeton pectinatus* directly not connected with the reed screen one can meet with a population characterized by the dominance of larvae of *Enallagma cyathigerum, Ischnura pumilio, Erythromma najas, Cloeon dipterum, Micronecta pusilla* and Chironomidae.

The spots of *Myriophyllum spicatum* directly connected with the reed screen already provide conditions of life for a macrofauna more avaried as to quality.

In the pondweed stands of the clearings enclosed in the reeds the macrofauna proved richer both in quality and in quantity than in the open-water pondweed

ields. In the first place varied communities of phitophagous Chironomidae, Ephemeroptera, Odonata, Trichoptera, Heteroptera, and Gastropoda have formed here.

As compared with the open-water pondweed fields, a qualitative difference appeared also in the circumstance that, instead of *Micronecta pusilla*, a Heteroptera community consisting mainly of *Naucoris cimicoides, Cymacia coleoptrata* and *Sigara striata* was characteristic of the pondweed fields in the clearing enclosed in the reeds. However, the quantity of the single taxa as compared with one another was different so-to-say in each of the habitats. Out of the isolated pondweed fields those consisting of *Myriophyllum verticillatum* and *Utricularia vulgaris* had the richest macrofauna. The macrofauna of the spots of *Potamogeton pectinatus*, also frequent in the reed zone proved the poorest as to quality.

The dominant organisms of the *Utricularia vulgaris* fields were, besides the Chironomidae, various Hirudinoidea species. In the pondweed stands of the clearings enclosed in the reeds, similarly to the open-water habitats, the most frequent species of mayflies was *Cloeon dipterum*. On the other hand, of the spots of *Utricularia* and *Najas*, being in closer connection with the sediment, the species of *Caenis* were characteristic.

Population dynamic and synbiological comments

The examinations conducted with monthly frequency in the vegetation period also permit to draw approximating conclusions on mass dynamism. The changes in dynamism and our observations of synbiology are going to be surveyed by animal groups.

Gastropoda

Their quantity increases in the course of the vegetation period. Relying on the numbers of frequency the mass dynamism of the single species does not present a clear picture. Frequency numbers meaning a higher number of individuals often also occur at the beginning of the vegetation period in certain species (Table 1).

Hirudinoidea

The characteristic organisms of isolated pondweed fields. Their relative quantity is particularly significant at the beginning and at the end of the vegetation period.

Isopoda

Asellus aquaticus as a characteristic detritus-inhabiting species has a significant part in the exchange of substances of the reeds. According to the data of Imhof and Burian (3), the number of their individuals per square metre is bet-

Table 1. Detailed survey of the demonstrated Gastropoda, Hirudinoidea and Isopoda species

Taxa	Month											
	1971						1972					
	M	J	J	A	S	O	M	J	J	A	S	O
Gastropoda												
Limnaea stagnalis L.	3						2	2				
Planorbis planorbis L.	3						3	3				
Radix auricularia L.						1						
Radix peregra MÜLL.	2	3			1	4	2	2	1	1		4
Physa fontinalis L.						4	1				3	
Bithynia tentaculata L.	2					2	2	3		1	1	2
Armiger crista L.						3	3	3			3	3
Gyraulus laevis ALD.	1					1						
Galba truncatula MÜLL.		1										
Hirudinoidea												
Theromyzon tessulatum O. F. MÜLL.	2	1	3	1		1	1	1			1	1
Helobdella stagnalis L.	2		1				2	2				
Piscicola geometra L.	2				1	1	1					
Hemiclepsis marginalis O. F. MÜLL.									1			
Glossiphonia heteroclita L.	4				3							
Hirudo medicinalis L.	1						1	1				
Erpobdella octoculata L.					1	1						
Isopoda												
Asellus aquaticus L.	1		1		2	3	1	1			2	2

ween 150 and 400 in the reed zone. Their quantity in pondweed fields is much smaller. They are to be found mainly in the *Utricularia vulgaris* stands situated closer to the reeds.

Ephemeroptera

The larvae of *Cloeon dipterum* and *Caenis horaria* are frequent organisms of the pondweed fields in every season of the year. Their population dynamism can be represented by a bicuspid curve. Their quantity is greatest at the beginning and end of the vegetation period.

Odonata

Permanent and characteristic inhabitants of the pondweed fields of extensive lakes. Their biomass is considerable during the whole vegetation period. The demonstrated species are enumerated in Table 2.

Trichoptera

The most frequent caddis-fly species of the Fertő pondweed fields in *Cyrnus (flavidus?)*. Besides it, also the species of the genera *Oecetis*, *Agrypnia* and *Ecno-*

Table 2. Itemized enumeration of the Ephemeroptera, Odonata and Trichoptera larvae

Taxa	Months											
	1971						1972					
	M	J	J	A	S	O	M	J	J	A	S	O
Ephemeroptera												
Cloeon dipterum L.	1	3	2	4	2	4	1	2	2	2	1	3
Cloeon simile ETN.	1			1							1	
Caenis horaria L.	1	1	1	1	3	4	1	2		1	3	3
Caenis robusta ETN.	1	1	2	1	1	1	1	1	1		2	2
Odonata												
Sympycna fusca LINDEN	1	1							1			
Ischnura elegans LINDEN					1	1						
Ischnura pumilio CHARP.	2				3	2	1	1		2	1	
Enallagma cyathigerum CHARP.	1		1	2	3	1	1	1		3	1	
Coenagrion puella L.			1			1	1		1			
Coenagrion pulchellum LINDEN			1				1	1				
Erythromma najas HANSEM.	1		1	2	1	1	1				1	1
Agrionidae juv.	3	1	1	4	4	4	4	2				
Aeschnidae juv.			3	2		1					2	2
Crocothemis erythrea BRULLÉ	1											
Trichoptera												
Cyrnus (flavidus McL.?)	2	2	2	1	2	2		1	1	1		1
Holocentropus picicornis STEPH.	1	1	1			2				1		
Ecnomus tenellus RAMB.				1	2	1						
Agraylea multipunctata CURT.				2		3						
Agrypnia pagetana CURT.					2	2	1	1				1
Phryganeidae juv.					1	3						
Atrhipsodes senilis BURM.							1			1		
Atrhipsodes sp. I.							1					
Atrhipsodes sp. II							1					
Oecetis ochracea CURT.			1									
Oecetis furva RAMB.			1		1	3	1		1	1		2
Oecetis sp.			2									

mus are frequent. According to the data of IMHOF and BURIAN, the quantity of caddis-flies in the reed zone may attain a number of individuals of 30 per square metre. In pondweed fields there live partly other species smaller in stature, and therefore, their biomass is, in all probability, smaller. It is worth remarking that during the two years' examination period Limnephilidae species did not turn up.

Coleoptera

Larvae and imagos of Coleoptera were found in remarkably small numbers of individuals and species in the pondweed fields of Lake Fertő. As they are rather mobile organisms, the small numbers of species and individuals are probably consequences of a fault in the collecting method.

Table 3. The frequent taxa of Lepidoptera, Coleoptera, Heteroptera and Diptera of the pondweed fields of Lake Fertő

Taxa	Months											
	1971						1972					
	M	J	J	A	S	O	M	J	J	A	S	O
Lepidoptera												
Nymphula nympheata L.	1	1		1	1		1	1				
Paraponyx stratiotata L.						3					1	2
Coleoptera												
Noterus crassicornis MÜLL.				1				1				
Haliplidae larvae			1									
Dytiscidae larvae	1	1	2	1			1	1				
Hydrophylidae larvae	1	1		1								
Heteroptera												
Micronecta pusilla HORV.	4	1	4	4			4	2	3	3	1	
Plea leachi MC GR. & K.	3	1	1	1	1		1	1	1	1	1	
Cymatia coleoptrata FABR.	4	1	2	3	2	2	4	3	3	2	4	4
Sigara striata L.	1	1	2	3	1	4	1	1	2	3	4	4
Notonecta glauca L.	1											
Ranatra linealis L.				1								
Naucoris cimicoides L.	2	1	3	1	1		2	1	3			
Corixidae larvae	4	4	1				4	4	3	3	2	
Diptera												
Chironomidae	4	4	4	4	4	4	4	4	4	4	4	4
Chaoboridae			1					1			1	
Ceratopogonidae	1											
Culicidae		1										

Lepidoptera

The found two species are of sporadic frequency. For outlining their mass dynamism the numbers of individuals are not high enough (Table 3).

Diptera

The larvae of Chironomidae are the most frequent macro-organisms of the fauna of the pondweed fields. As a rule, the number of their individuals and in all probability also the one of their species surpass those of all other groups.

Heteroptera

In spring, the demonstrated 8 taxa show maximum frequency of occurrence mainly in May then, contrarily to the other groups, at a somewhat earlier time, in August–September. Merely 1 specimen of *Ranatra linearis* was collected by the author, only in August, 1971. The occurrence of the Heteroptera clearly indicates the ecological difference between the pondweed fields of the open water and the reed zone.

Table 4. The frequent Hydracarina of the pondweed fields

Taxa	Months											
	1971						1972					
	M	J	J	A	S	O	M	J	J	A	S	O
Hydracarina												
Eylais excendes MÜLL.	1				1		1	1			1	
Eylais sp.	2	2			3		3	2			2	1
Hydracna globosa GEER.	3			1	1		3	1		1	1	
Georgella helvetica HALL.	1							1				
Hydrodroma despiciens MÜLL.	2			2	2		2	1		2	2	
Neumania deltoides PIERS.	1											
Limnesia fulgida C. L. KOCH	1							1				
Piona coccinea KOCH.	1						1					
Piona alpicola NEUM.	1						1					
Piona sp. I	2											
Piona sp. II	2						2					
Arrenurus bicuspidator MÜLL.	2	2					1	1				
Arrenurus cuspidifer PIERS.	1	1				1						
Arrenurus tricuspidator MÜLL.	1	2		1	2		2	2	3	1	3	2
Arrenurus sp.	4	4	3	3	4	4	3	3	2	3	4	4

Hydracarina

The number of both their species and individuals are significant. In spring the *Piona* and *Eylais* species appear first, then, during summer and in autumn, one most often meets with the species of the genus *Arrenurus*.

By way of evaluation, one can say that the character and approximative quantitative data of the macrofauna reflect the extremely eutrophic type of the Lake. The dominance of the species with wide toleration capacity in the animal groups examined by the author can be well explained by the astatic character of Lake Fertő.

REFERENCES

1. ANDRIKOVICS, S. (1973): *Hidroökológiai és zoológiai vizsgálatok a Fertő hínárosaiban. (Hydroecological and zoological examinations in the pondweed fields of Lake Fertő).* – Állatt. Közlem., 60: 39–50.

2. BIRÓ, K. & GULYÁS, P. (1974): *Zoological investigations in open-water Potamogeton pectinatus stands of Lake Balaton.* – Annal. Biol. Tihany, 41: 181–203.

3. IMHOF, G. & BURIAN, K. (1972): *Energy flow studies in a wetland ecosystem (Reed Belt of the Lake Neusiedler See).* – Special Publication of the Austrian Academy of Sciences for the IBP: 1–15.

4. MÜLLER–LIEBENAU, I. (1956): *Die Besiedlung der Potamogeton-Zone ostholsteinischer Seen.* – Arch. Hydrobiol.: 470–606.

Opusc. Zool. Budapest, XVI, 1–2, 1979

On the Geographical Distribution of the Archemorus Species (Araneae, Argyopidae)

By

P. Balogh*

Abstract. Author summarizes the distribution and ethology of the known species of genus *Archemorus* (Araneae, Argyopidae). Before starting investigation only 8 species were known to belong in the genus collected in 12 localities. His material comprises 14 species collected in 230 specimens from 92 localities. On the basis of this relatively rich material the author analyses the geographical distribution of the species, their probable origin and some notes are appended to certain species concerning their hitherto unknown ethology.

While arranging the materials deriving from the collections made by the Hungarian Soil-zoological Expeditions in New Guinea and New Caledonia, and the material of the Bishop P. Bernice Museum (Honolulu) originating from the same regions it was striking to note the large number of species belonging in the genera of *Archemorus* and *Arcys*. Upon identifying the material the *Arcys* specimens proved to be three known species, while the majority of *Archemorus* are new to science. The description of the ten new species is published elsewhere (P. Balogh, 1978). The present contribution is aimed at to elucidate the geographical distribution of the species of *Archemorus*.

The spider fauna of the world, discounting the Holarctic region, is very inadequately known; this fact obviously applies to the species of *Archemorus* too. The literature brings forth a mere eight species, known from a total of 23 exemplars collected at 12 localities. They are distributed over Buru Island, New Guinea, eastern shores of Australia, Tasmania and Lord Howe Island. The material elaborated by me proves the presence of the genus in New Caledonia too. My material comprises 14 species from a total of 230 specimens collected at 92 localities. This large number of specimens and wider spectrum of distribution allow me to sketch up the range of this genus.

The comparison of literary data and my material is as follows:

* *Dr. Péter Balogh*, Természettudományi Múzeum Állattára (Zoological Department of the Hungarian Natural History Museum), 1088 Budapest VIII., Baross u. 13.

	Literature	Own material	Total
Number of species	8	14	18
Number of locality	12*	92	104*
Number of specimen	23*	230	253*

* In some cases where numeric data were not available I used a probable mean-value.

The present material, which is ten times as large as the earlier one, might suggest that on the basis of my work the distribution of the genus *Archemorus* is known. It is without doubt that in the Pacific region no other genus has such high number of data for reference. On the other hand, the examined material and the results are thought provoking.

The early materials yield 1.9 specimens per collecting locality; the average number of specimens per species is 2.9. The average specimen number per locality in my material is 2.5; the average number of specimens per species is 16.4 thus, higher values are available in both cases. On the other hand, the literary data and my material cannot be compared since there is significant difference between the two as far as distribution area is concerned. Let us see this is the following table:

	Australia		New Guinea		New Caledonia		Sunda Islands	
	lit.	own	lit.	own	lit.	own	lit.	own
Number of species	4	6	2	5	–	3	2	–
per cent	50,0	42,9	25,0	35,7	–	21,4	25,0	–
Number of collectings	8	11	2	61	–	20	2	–
per cent	66,6	11,9	16,6	65,2	–	21,6	16,6	–
Number of exemplars	16	16	2	131	–	83	5	–
per cent	69,5	6,9	8,7	56,9	–	36,0	21,7	–

The table reveals the following evidence:

1. No literary data are available from New Caledonia; on the other hand, I have no data for the Sunda Islands.

2. Among the literary data those from Australia are dominant both as far number of collectings and number of exemplars are concerned; New Guinea is falling behind; on the other hand, my data show the exact opposite of the above.

3. The species number, referring it to absolute specimen number is high in both cases (4 and 6); this means that the percentage of the species is almost the same; the percentage of specimen number is very high in the case of literature, in the case of my data very low.

Considering what has been said above, the following conclusions can be drawn. It is obvious that the majority of data from the literature derive from the last century or from early 20th century. Those collectors gathered everything at that time, they had scanty knowledge of spiders, performed their collectings simply, without using any mechanical devices. We might venture to say that

the animals were secured accidentally, consequently, in low number. In New Guinea the collectings took place but seldom. Thus, it is obvious why the majority of data originate from Australia.

On the other hand, the Hungarian Soil-zoological Expeditions comprised experts knowing spiders well; they mainly collected spiders; they applied mechanical devices (net, insect umbrella), consequently, long series of animals have been collected; furthermore, special care was invested in the canopy level, where the species of *Archemorus* are living. These collectings took place in the majority of cases in New Guinea and New Caledonia; they made collectings in Australia but here at a few localities only and for a shorter period of time.

The material belonging in the Bishop Museum was collected by full-time collectors but not by arachnologists; the collectings are evenly distributed over New Guinea, they frequently collected in New Caledonia too, while they did not send the Australian material to Budapest for elaboration. Therefore, the Australian material are scanty both in the soil-zoological collectings and in the collection of the Bishop Museum.

Attention should be drawn to the fact, that the comparatively small material deriving from Australia, 11 collectings with 16 specimens, in fact harboured 6 species of which 4 are new to science. This striking fact indicates that further species of *Archemorus* are to be expected to come forward from Australia. It might well be that the origin of the genus should be looked for in Australia.

Evaluation of the heretofore collected material

The discrepancy between literary data and my material is somewhat levelled out when we integrate the two materials and consider them as one. In the following I introduce the two as one in tabulated form.

Species	Specimen	Percentage of specimen	Number of collecting
rosdorpi CHRYSANTHUS	62	24.50	41
montanus P. BALOGH	60	23.71	4
kaszabi P. BALOGH	39	15.41	6
varians P. BALOGH	36	14.22	12
simsoni SIMON	10	3 95	6
sibil CHRYSANTHUS	8	3.16	8
alatus KEYSERLING	7	2.76	4
vicarius P. BALOGH	6	2.37	6
occidentalis REIMOSER	4	1.58	2
tuberculatus P. BALOGH	4	1.58	2
cicatrosus RAINBOW	4	1.58	1
coronatus P. BALOGH	3	1.18	3
dilatatus P. BALOGH	3	1.18	2
grandis P. BALOGH	2	0.79	2
furcatus P. BALOGH	2	0.79	2
curtulus SIMON	1	0.39	1
toxopeusi REIMOSER	1	0.39	1
transversus P. BALOGH	1	0.39	1
	253		104

The present table gives data in decreasing order much resembling those so-called "cenological" tables which are designed to illustrate the material of quantitative surveys. Interestingly enough, here too are some "dominant" species which, when compared to others, display strikingly high number of specimen, thus, when the corresponding percentage values are given they represent a significant part of the total. The first four species: *rosdorpi*, *montanus*, *kaszabi* and *varians* yield 197 specimens, i. e. 78 per cent of the whole; number of collectings 63, giving 60 per cent of the total. The rest, 56 specimens, is divided among 14 species. This obviously means that the known 18 *Archemorus* species can be divided into two major groups as far as "dominance" is concerned. The average specimen number of the first four species is 49.25, while the rest yields (of the 14 species) only 4.

In analyzing further the 4 species with high specimen number, first the *varians* should be considered. This species occurs in New Caledonia, thus, it has no direct connection with the other three species living in New Guinea. On the other hand, the other two New Caledonian species: *vicarius* and *grandis* of low specimen number are known from 6 and 2 specimens, respectively. When we compare these New Caledonian species with one another, then we find, that *varians* is "dominant" again over the other two: with 44 specimens it yields 81.8 per cent of the total number. Finally, if we compare the three "dominant" species out of the five New Guinea species, then we find that *sibil* and *coronatus* show a very low percentual value against the 93.6 per cent of the other three together. Thus, the principle of "dominance" is ever more striking when projected over a small region than over the entire Aus – tralian region. As far as New Guinea is concerned I have to say that from among the three "high dominance" species one: *rosdorpi* inhabits the montane forest zone, while the other two are found in mossy forest. Thus vertically it is separated just so as it is separated from the New Caledonian *varians* geographically.

In summarizing we may conclude that the general principle also applies within the genus of *Archemorus* as in other genera, that in one area one species is dominant while the other species are rare and collected only in small numbers. Since the ethology and ecology of *Archemorus* species are scarcely known we do not know how well the collectings illustrate the distribution and ratio of the species in nature. In the following our present knowledge is given in brief, as far as this question is concerned.

Ecology and ethology of the species

Species belonging in the group of Arcyeae, discovered first, have not been characterized ethologically. L. Koch writes in his great work on Australian spiders that the ethology of Arcyeae is wholly unknown (Koch, 1872, p. 215 – 216). The authors of the species received only dead specimens, it is most likely that Simon had the same fate, who described the genus in 1893. First it was Rainbow, an Australian arachnologist, who studied the life history of these animals. Observations referring to these species are published in Main's (1976, p. 212) book. Accordingly, the species belonging in this group spin no web at all; their preys are seized in a fashion as the crab spiders do. It is very probable that the length of the first two pairs of legs, the strong, spiny chaetotaxy are in functional relation

with this mode of prey taking. According to the observation of MASCORD (1971) the *Arcys* species hold their fore legs forward when seeking a prey, while the *Archemorus* species more or less in normal situation in lateral position.

It might be worth mentioning that the length of the 3rd and 4th pairs of legs in the *Archemorus* species scarcely differ from the first pair; and this also apllies to the newly discovered species too.

The members of the Hungarian Soil-zoological Expeditions very rarely observed the *Archemorus* species directly. They have seen most frequently *Archemorus rosdorpi* sitting on the branches of bushes and small trees. All the specimens derive from the foliage, from the canopy level through applying the so-called beating method.

All the so far known species of *Archemorus* are forest dwellers; the majority favour closed, dense and humid forests. In most cases they came forward from the mossy-forests of New Guinea at an altitude of 2800—3600 m. In this vegetation zone two species: *Archemorus kaszabi* and *A. montanus* are rather frequent. No closer biotope data are available for the two species. On the basis of collecting data however it can be stated that the 39 specimens of *kaszabi* and the 60 specimens of *montanus* do not occur in the material at the same locality at the same time.

In montane forests, further three species live in New Guinea. The most common one being *A. rosdorpi* (from 41 collectings 61 specimens) in fact yields 24.5 per cent of the total specimen number in my material. They do not occur in montane forests only but they are found also around houses, in parks, on trees, shrubs. Thus, e. g. in the park of the Wau Ecological Institute they have also been collected. Its range of altitude is also variable: it is found between 1000 and 2600 m. Another montane species is the *Archemorus coronatus*. Only three specimens are known from between 1200 and 2700 m. We have no data concerning its ethology and ecology. The dame distirbution is noted for the species of *A. sibil* collected between 800 and 2500; each time only a single specimen was collected.

The three New Caledonian *Archemorus* species: *grandis, varians* and *vicarius* deserve special attention. The mountains in New Caledonia are no higher than 1700 m. The elaborated material derives from much lower altitudes: below 1000 m, but it is characteristic for the ecology of three species living here that they have been collected on the very same day on an area smaller than one hectare in a small forest on Ile des Pins. Altitude below 100 m, though a systematically close relative of *varians* is *montanus* living in the mossy-forests of New Guinea between 2200 and 3600 m. The species though morphologically quite similar ecologically and as far as altitude is concerned sharply differ from each other. Apparently *Archemorus varians* is the vicariant species of the New Guinean *montanus* having adapted itself to lower altitudes in New Caledonia. We might suppose that their common ancenstor is till living or lived in Australia, where we might place the origin of the genus *Archemorus*. This is also proved by the case of *A. vicarius*. This species is an ally of *A. dilatatus* inhabiting the subtropical rain-forests of Queensland. The distribution of the two species are more similar than that of the previous two species which have diverged ecologically and also in altitude. The ecology of *A. grandis* is unknown. The only specimen collected in the canopy level of dense, tropical karst forest settled on coral limestone rock-bed.

The *Archemorus* species may be encountered from Tasmania upwards to the tropical *Eucalyptus* forests of Queensland without interruption. Ecologically, all species adhere to dense, undisturbed, humid forests. They are found both in the *Notofagus*-zone and in various temperate fern-forests, along Australia's eastern, rainy sea-shore forest belt. Of the six collected species four were new to science. A total of 16 specimens were secured, unfortunately, nothing can be said about their ecology.

Distribution of the species

The fauna of Australia and neighbouring lands developed since the Eocene until the present day. According to MACKERRAS (1973) the Auastralian fauna comprises five principal faunal elements.

1. Ancient elements: such primitive forms which survived since the Palaeozoic or Early Mesozoic, and as relics scarcely changed at all. Among the the vertebrates we find the lungfishes (Dipnoi), among the invertebrates the Onychophora.

2. Southern elements (Antarctic, South-Gondwana elements): they are characterized by two points; *a)* they represent an early stage of evolution of most orders, thus, e. g. almost all primitive sections of families in Nematocera (Diptera), and scarecly any from among the higher Diptera (Cyclorapha – Schizophora]. *b)* Their distribution area are Australia – South America, rarely Australia – South Africa – New Zealand.

3. Old northern elements (pantropic, Lemurian elements): the evolutionary centres of these are in Africa and Madagascar, whence they spread over the Indian Ocean to New Guinea and Australia, as well as into the Pacific islands.

4. Young northern elements (Oriental, Indo-malayan, partly Papuan elements): these may be considered to be such elements of Oriental origin which arrived to the region through New Guinea and Indonesia. To this group belong such highly developed forms, at the acme which represent almost all living orders in the region.

5. Recent elements; they may be *a)* air-borne planktonic elements of tiny size, *b)* actively migrating, well flying elements, or *c)* introduced by the activity of man.

The majority and the most characteristic elements of the Australian aunaf derive from points 2 and 4, i. e. from the Antarctic and Oriental – Indo-malayan elements.

BARBARA MAIN (7) attempted in her recently published book to evaluate the Australian spider fauna from this aspect. Her conclusions are quite acceptable, especially in considering the family of Argyopidae as a "modern" group of spiders, i. e. they are in the prime of their evolution. If we start off from this inevitable fact then we should suppose that the Arcyeae group belongs in the Oriental – Indo-malayan elements.

To which faunal element this group belongs cannot be as yet decided, since *1.* It is a fact that all the species of the genus *Archemorus* live east to the Weber-line, i. e. inhabit Australia, New Guinea and some neighbouring islands. But this fact still does not allow me to conclude for certain that they originate

from there. We should accept MACKERRAS when he drew attention to the difference existing between "autochton" and "endemic" species (MACKERRAS, 1973, p. 191 – 192).

2. It is a fact that all species of *Archemorus* live in rain-forest, or in humid forest. The rain-forest conserves ancient forms. Ecosystems well corresponding to rain-forests have beem in existance since the Carbon: thus we can say with certainty that these ecosystems sustained forms from the Carbon to our present days.

3. It is a fact that the species of the genus *Archemorus* secondarily have lost their ability to spin a web, characteristic for the subfamily Argyopinae; it is a fact that they are at their acme, and are specialized forms, but these do not exclude the possibility that they developed since the Carbon continuously, thus at one time they originated from an ancient group. The tropical rain forests, existing since the Carbon, gave a well balanced ecosystem rending it habitable either for ancient or modern forms.

Weighing up what has been said above I have to conclude that neither the origin nor their belonging to a faunal element is certain. It is probable that after elaborating the spider fauna of Australia, and more especially those of New Guinea and New Caledonia we obtain a better picture of the problem and might be able to give better answers. Materials deriving from these regions are under investigation and shall be elaborated soon. These materials contain numerous specimens from the lower tropical rain forests, montane forests and mostly from the mossy-forests (canopy level) collected by special methods. They are in close connection with moss and the epiphyton vegetation, thus they may serve in supporting some biogeographical and evolutionary conclusions far better than a genus with a small number of species only.

Distribution of Archemorus species

In sketching up the distribution of the species and to interpret this picture I fell back upon the following facts:

1. Facts concerning the ethology of the species: though as far as relation is concerned they belong in subfamily Argyopinae, they have lost their ability to spin a web; and secondarily they adopted a prey-taking method characteristic for the crab spiders. Thus, they seize settling insects rather than flying ones. To this mode of prey-taking their fore pair of legs is modified for capturing animals.

2. Facts concerning the ecology of the species: living on leaf surfaces closely attaches the animals to the canopy level, or in other words to the forest. An environment rich in food, climatically hardly changing, almost like a "glass-house" together with the above mentioed mode of activity made them extremely sedentary in nature.

3. Facts concerning the distribution of the species: the area of the species is small in general (compared to the other spiders!); they are inclined to be vicariant both geographically and ecologically, i. e. vegetation level. Their distribution much resembles those of some terricolous, apterous insects.

Starting from these facts the so far known species of *Archemorus* may be ranged in the following distribution types:

A) In Australia:

1. Species in the Bass province:

Archemorus simsoni SIMON, 1893
Archemorus alatus (KEYSERLING, 1890)
Archemorus transversus P. BALOGH, 1978

2. Species in the Torres province:

Archemorus tuberculatus P. BALOGH, 1978
Archemorus furcatus P. BALOGH, 1978
Archemorus dilatatus P. BALOGH, 1978

B) In New Guinea:

3. Montane forest species:

Archemorus sibil CHRYSANTUS, 1971
Archemorus rosdorpi CHRYSANTHUS, 1971
Archemorus coronatus P. BALOGH, 1978

4. Mossy-forest species:

Archemorus montanus P. BALOGH, 1978
Archemorus kaszabi P. BALOGH, 1978

C) In New Caledonia:

Archemorus vicarius P. BALOGH, 1978
Archemorus grandis P. BALOGH, 1978
Archemorus varians P. BALOGH, 1978

1. The species living in the Bass province

The Bass province as it is well known, more or less coincides with the temperate forest zone; to this region belong the forests of West Australia, Tasmania, Victoria and New South Wales. It is noteworthy that this region corresponds to the *Notofagus*-belt: the beech-forests of the Northern Hemisphere are substituted in the south by extensive *Notofagus*-forests. It may be supposed that the ancient, antartic faunal elements, especially the forest dwelling forms found shelter in this region. Unfortunately, the spider fauna of this region is well-night unknown, excepting perhaps that of New Zealand. It would not be surprising to encounter several new species in this region. The species known from the literature as *Archemorus curtulus* may also belong here.

2. The species living in the Torres province

The Torres province comprises the subtropical and tropical forests of Australia. The three new species which I described from this region represent three different trends of development; the possibility is not excluded that they are in fact members of different species-groups or perhaps represent new subgenera. The species *tuberculatus* is related to *sibil* from New Guinea, the *dilatatus* with *vicarius* from New Caledonia, while the *furcatus* with its peculiarly situated eyes.

development of thorax and fore tibia does in fact differ from all other congeners almost on generic level. The great variability of forms, the large number of new species suggests that the centre of the genus is at this region.

3. The species living in the montane forests of New Guinea

All three species are of large body size, from among them *rosdorpi* is the commonest form of the genus. It is in close relation with *occidentalis* inhabiting the Buru Island; the latter is the westernmost representative of the genus. On the other hand, *Archemorus sibil* points towards the Torres province, while *coronatus* is a very oddly developed species. Its close ally is so far unknown.

4. The species living in the mossy-forests of New Guinea

A total of 99 specimens, i. e. 40 per cent of all the collected specimens, belong into two species. The large series of collectings suggests that this region is the best collected one of all. *Archemorus kaszabi* is the most specialized, very small species. As far as we know at present it is without a relative.

5. The species living in New Caledonia

The *Archemorus* species zoogeographically are extremely interesting. All three species are new to science: the occurrence of the genus in New Caledonia is shown for the first time. The species *vicarius* is in close alliance with *dilatatus* living in Queensland; the species *varians* with *montanus* inhabiting the moss-forests of New Guinea, while the species of *grandis*, the largest species of the genus, shows no relation either in Australia or in New Guinea. The two previous species morphologically are related, nevertheless they are well separable from their allies. Further two *Archemorus* species may be expected from New Caledonia: one resembling *sibil—tuberculatus*, perphaps a tiny species (only juvenile forms have been secured); the other related to *simsoni* (again only juvenile forms have been collected). It is a striking fact, that the spider fauna generally poorly represented in New Caledonia provides good grounds for the genus *Archemorus* (five species): the same number as in New Guinea, and scarcely smaller than in Australia.

Final conclusions

The species pairs in close alliance allow me to draw possible conclusions as to the sequence of populating the examined area. As a starting pair, let us consider *sibil—tuberculatus*, whose younger representatives are also found in New Caledonia. It is quite probable that we are in fact dealing here with three closely related species, of which sibil is the most ancient of form. This form gave rise to *tuberculatus* in the continent of Australia, while in New Caledonia a yet undescribed species is present represented by the juvenile form. If we accept this hypot-

hesis then we must consider the *sibil* species-group as an oriental-indomalayan element which arrived in the Australien region through New Guinea.

There is another hypothesis: let us suppose that the *Archemorus* group derives from a primitive ancestry, and as a southern, antarctic element migrated northwards. In this hypothesis the evolutionary series is *tuberculatus – sibil* and the New Caledonian species; the migration route also follows this course.

All other inferences display this dual possibility. Only one populating trends can be accepted as fairly probable: New Caledonia received its species from west and not vice versa. Species pairs representing the evolutionary trend is *simsoni* – New Caledonian juveniles – *simsoni: dilatatus – vicarius: montanus – varians* unequivocally prove that New Caledonia received faunal elements from the Bass province, from the Torres province, from the montane forests of New Guinea and also from the mossy-forests of New Guinea. As to how the population took place and in which period we have no information. Nor do we know much about the mode of distribution, how the ethology, biology and other features of the *Archemorus* species influenced dispersal.

The surprising fact that New Caledonia yielded three known species, and another two yet undescribed species (juvenile forms only) of the genus *Archemorus* may perhaps be explained by the extremely low number of Thomisid species persning a mode of living resembling that of a crab spider. Accordingly, this mode of prey-taking was taken over by the species of the genera *Archemorus* and *Arcys*.

The above discussed problems are quite interesting but final answers may only be given after the elaboration of the spider material covering the entire of New Caledonia, New Guinea and Australia.

REFERENCES

1. Balogh, P. (1978): *New Archemorus species (Araneae, Argyopidae).* – Acta. Zool. Hung., 24: – Acta. Zool. Hung., 24: 00 – 00.
2. Bonnet, P. (1945): *Bibliographia Araneorum. Tom. I.* – Toulouse, 1 – 832 pp.
3. Chrysanthus, O. F. M. (1971): *Further notes on the spiders of New Guinea. I. Argyopidae.* – Zool. Verh., 113: 1 – 52.
4. Keyserling, E. (1884 – 1890): *Die Arachniden Australiens.* – Nürnberg, 274 pp.
5. Koch, L. & Keyserling, E. (1871 – 1883): *Die Arachniden Australiens.* – Nürnberg, 1489 pp.
6. Mackerras, I. M. (1973): *Composition and distribution of the fauna.* – In: The insects of Australia. Melbourne: 187 – 202.
7. Main, B. Y. (1976): *Spiders.* – Sydney, 296 pp.
8. Mascord, R. (1971): *Australian spiders in colour.* – Sydney, 200 pp.
9. Rainbow, W. J. (1920): *Arachnida from Lord Howe and Norfolk Islands.* – Rec. S. Austral. Mus., 1: 229 – 272.
10. Reimoser, E. (1936): *Fauna Buruana. Arachnoidea.* – Treubia, 7, Suppl.: 405 – 413.

Opusc. Zool. Budapest, XVI, 1–2, 1979

Ökologisch-produktionsbiologische Typen in der Tierwelt

Von

G. Gere*

Abstract. Numerous literature data support the view that from the viewpoint of production biology some characteristics of various animal species similarities may be observed. This similarity may cover, body-weight, rate of growth, material components of body, quantity of consumed food, quality of breaking down, etc. Obviously, these similarities are more frequent among related species, but may also be observed between species taxonomically placed far from each other. On the basis of these similarities the different animals may be grouped to ecological and production biological types. Typization solves the problem that every form of a species be studied during the investigation of material and energy turn-over of the ecosystems. This may render help in future production biological investigations.

Die Erkenntnis der in den Ökosystemen sich abspielenden Stoff- und Energieveränderungen gehört zu den wichtigsten Aufgaben unserer Tage. Die Fragen dieses Themenkreises wollten schon viele und auf vielerlei Art beantworten. Um in die Funktion des Ökosystems, eines ausserordentlich verwickelten Komplexes einen Einblick zu gewinnen, bieten sich sowohl theoretisch als auch praktisch zweierlei Annäherungsmöglichkeiten: die induktive und deduktive Untersuchungsform. Zum Ermessen der Produktion der Pflanzengesellschaften wird die aus den höheren Einheiten, selbst aus dem Gesichtspunkt der Vergesellschaftung in Gang gesetzte Untersuchungsmethode in weitem Kreise angewendet. Bei der Untersuchung der Tiergesellschaften ist es in gesteigerterem Masse erforderlich, dass wir zuerst die Lebensprozesse der Individuen bzw. ihrer Semaphoronten (Hennig, 1950; Szelényi, 1955) erkennen und so auf synthetischem Wege bis zur synbiologischen Kenntnis der Arten, sodann der Populationen gelangen, um dadurch schliesslich über die Gesamttätigkeit der tierischen Komponenten, der Ökosysteme ein Bild verschaffen zu können. Der Grund hiefür liegt darin, dass die Tierwelt von produktionsbiologischem Gesichtspunkt viel heterogener ist als die Pflanzenwelt. Diese Tatsache bedeutet zugleich auch soviel, dass die Aufgabe ausserordentlich schwer, fast als unlösbar zu betrachten ist, da ja wir

* *Dr. Géza Gere*, ELTE Állatrendszertani és Ökológiai Tanszék (Lehrstuhl für Tiersystematik und Ökologie der Eötvös-Loránd Universität), 1088 Budapest VIII., Puskin u. 3.

hiezu – wie es aus dem Gesagten folgt – über die quantitativen zönologischen Daten hinaus, in den gegebenen ontogenetischen Stadien einer jeden, im Ökosystem vorkommenden Art ihre von den gegebenen Umweltsbedingungen abhängende produktionsbiologische Tätigkeit kennen müssen. In diesem schweren Dilemma leistet eine grosse Hilfe, dass die Tiere sich – meines Erachtens – von ökologisch-produktionsbiologischem Gesichtspunkt aus in Typen teilen lassen.

Unter ökologisch-produktionsbiologischem Typ müssen wir das verstehen, dass die verschiedenen Tiere oft von einem oder von mehreren produktionsbiologischen Gesichtspunkten in bezug ihrer wichtigen Eigenschaften einander ähnlich sehen. Diese Ähnlichkeit kann z.B. innerhalb der Ontogenese hinsichtlich des Körpergewichtes oder der Wachtstumsgeschwindigkeit der Längenmasse, in der Zusammensetzung der Körpersubstanzen, in der Menge der Nahrungsaufnahme, in den qualitativen Indizes der Verdauung und des Stoffwechsels (Assimilation, Produktion, Respiration usw. [PETRUSEWICZ und MACFAYDEN, 1970]) und im allgemeinen in den verschiedensten biologischen Merkmalen bestehen. Es kommt vor, dass zwei Tierarten sich in irgendwelcher Relation nur unter gewissen, bestimmten Umständen als gleiche Typen benehmen, im Falle der Veränderung der Umstände hingegen bereits schon andere Typen repräsentieren. Es ist natürlich, dass die gleichen Typen unter den verwandten Arten häufiger anzutreffen sind, jedoch können sie öfters auch zwischen voneinander ganz weit liegenden Arten vorkommen.

Wir müssen in der Relation der Typen den Ausdruck: Ähnlichkeit betonen, denn es wäre falsch über Identität zu sprechen. Es scheint nämlich, dass die Eigenschaften der Arten im allgemeinen artspezifisch, im Falle derselben Typen hingegen die in den fraglichen Eigenschaften bestehenden Unterschiede gering sind und sie auf diese Weise besonders in Untersuchungen extensiven Charakters vernachlässigt werden können.

Im Zuge der Differenzierung der Typen darf nicht ausser acht gelassen werden, dass – besonders in den einzelnen Tiergruppen – auch zwischen den Individuen der Art beträchtliche Unterschiede in verschiedenster Hinsicht bestehen können. Deshalb lassen sich allgemeine Schlüsse nur aufgrund entsprechender grosser Serien ziehen.

Die Typen ermöglichen, die in den Ökosystemen tätigen Arten bzw. ihre Semaphoronten typenweise zusammenzufassen und sie einheitlich zu charakterisieren. Dies wird aller Wahrscheinlichkeit nach auch dorthin führen, dass es sich erübrigt, alle der erwähnten Arten – abgesondert voneinander – in Einzelheiten eingehend zu studieren, denn man kann dem Anschein nach in vielen Fällen aufgrund gewisser, leicht registrierbarer Eigenschaften auch auf den in anderer Relation genommenen Typ schliessen.

Das Gesagte lässt sich mit einigen Beispielen auch anschaulich unterstützen.

Abb. 1 zeigt einerseits die Gewichtsänderung von zwei, zu verschiedenen Ordnungen gehörenden (Hymenoptera und Lepidoptera) holometabolen Insektenlarven bis zur Verpuppung, andererseits die Gewichtskurve von zwei, verschiedenen Familien angehörenden Jungvögeln der Passeriformes von ihrem Ausschlüpfen aus dem Ei bis zu ihrem Ausflug aufgrund literarischer Angaben. Es ist gut sichtbar, dass die Entwicklungskurve der Insekten und der Jungvögel zweierlei Typen von ganz anderem Charakter vertreten. Innerhalb der Typen ist der Verlauf der Kurven – trotz der Unterschiede im absoluten Gewicht und

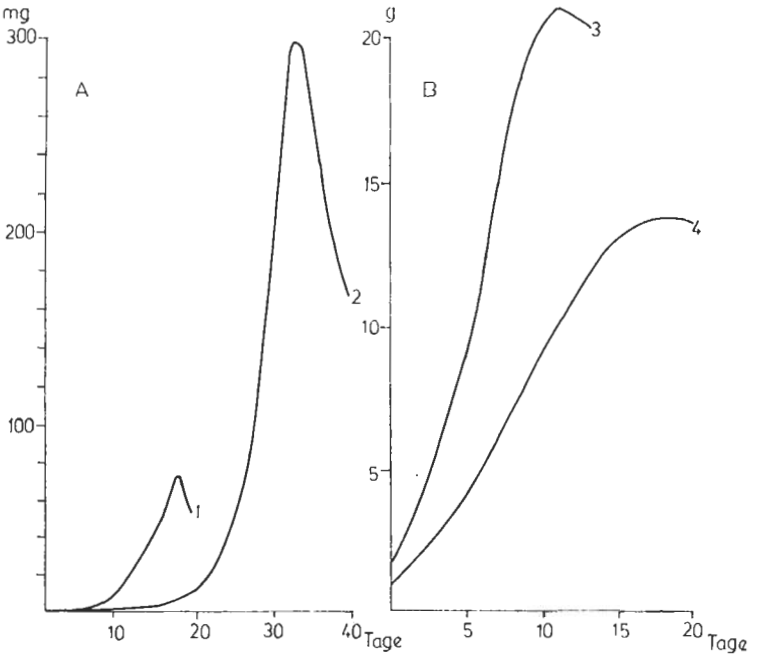


Abb. 1. Wachstumstypen nach literarischen Angaben. *A:* Gestaltung des Gewichtes von holometabolen Insektenlarven: 1. *Trichiocampus viminalis* (Hymenoptera; nach JANDA jr., 1958), 2. *Hyphantria cunea* (Lepidoptera; nach GERE, 1956 *a*). *B:* Gestaltung des Gewichtes von Jungvögeln der Passeriformes: 3. *Passer m. montanus* (Ploceidae; nach BAUER, 1975), 4. *Lonchura striata* (Estrildidae; nach GERE, noch nicht publizierte Angaben)

in der Entwicklungszeit der Tiere – ähnlich. Während das Wachstum der dargestellten Insektenlarven vom Lebensalter abhängend – von der letzten Phase ihrer postembryonalen Entwicklung abgesehen – durch die Exponentialfunktion am besten angenähert und die letzte Phase ihrer Entwicklung von einem enormen Rückfall im Gewicht charakterisiert wird, steht die leichte S-Kurve der Entwicklung bei den Jungvögeln – wieder von der letzten Phase abgesehen – der einfach linearischen Funktion näher als der vorangehenden.

Gewichtsänderungsmessungen wurden auch an mehreren holometabolen Insektenlarven und zu den Passeriformes gehörenden Jungvögeln durchgeführt. Die Ergebnisse waren praktisch genommen alle gleich. (Als Ausnahmen sind diejenigen Insektenlarven zu behandeln, in deren Entwicklung sich eine Diapause einschaltet.) An Hand all dieser haben wir starke Gründe anzunehmen, dass auch die Entwicklungskurve sonstiger, zu den betreffenden Tiergruppen gehörenden Arten gleichen Typs sind wie die vorangehenden. Die aktuellen Gewichtswachstumsuntersuchungen können wir bei diesen Arten im Laufe der produktionsbiologischen Wertung sogar ausser acht lassen.

Der Wachstumsgeschwindigkeit der Tiere fällt übrigens vom Gesichtspunkt des Stoff- und Energieumsatzes der Ökosysteme eine grosse Bedeutung zu. Abgesehen von mehreren, sich naturgemäss ergebenden Faktoren, lohnt es sich darauf zu achten, dass das Gewicht der oben erwähnten Raupe von *Hyphantria cunea* zur Hälfte der Entwicklungszeit der Larven (in 20tätigen Alter) bloss 3,7%

Tabelle 1. Fettgehalt verschiedener Insekten. Die Daten beziehen sich auf die Anfangsphase des Imagolebens, mit Ausnahme des Fettgehaltes von Melanargia galathea, dessen Feststellung aufgrund der Untersuchung alter Imagines erfolgte

Nr.	Art	Fettgehalt der Tiere (Lebendgewicht %) männlichen	weiblichen	Untersuchungsergebnisse von
1	*Hyalophora cecropia* (Lepidoptera)	33,5	9,4	Domroese und Gilbert, 1964
2	*Lymantria dispar* (Lepidoptera)	18,1	5,5	Gere, 1964
3	*Leucoma salicis* (Lepidoptera)	26,2	10,5	Janda und Marek, 1960
4	*Galleria mellonella* (Lepidoptera)	27,4	16,7	Balázs, Kováts und Burg, 1962
5	*Lysandra coridon* (Lepidoptera)	2,6	4,8	Gere 1977
6	*Melanargia galathea* (Lepidoptera)	3,8	4,5	Gere, 1977
7	*Acheta domesticus* (Orthopthera)	9,7	11,5	Lipsitz und McFarlane, 1970
8	*Chortippus parallelus* f. *microptera* (Orthoptera)	9,5	11,2	Gyllenberg, 1969

ihres Maximalgewichtes beträgt, zur selben Zeit erreicht der Jungvogel von *Lonchura striata* bereits in seinem 10,5 tägigen Alter (zur Hälfte seiner Entwicklungszeit innerhalb des Nestes) 68,9% seines maximalen Jungvogelgewichtes. Hingegen übertrifft die Raupe beim Beenden ihres Wachstums sogar das 5800 fache ihres Anfangsgewichtes, der Jungvogel erreicht hingegen bloss etwa das 15fache desselben im Nest. Diese Unterschiede modifizieren in entscheidender Weise die in der Interpretation von Petrusewicz und Macfayden (1970) genommene und vom Lebensalter abhängend sich ausbildende Konsumtion und Assimilation der zu zweierlei Typen gehörenden Tiere. Wir wissen, dass die Zahl der Individuen der einzelnen Populationen während ihres Lebens allmählich abnimmt, da die "marginalen" (Elton, 1927; Balogh, 1958) Individuen der Population für die folgende Ernährungsstufe als Nahrung verwendet werden. Hingegen müssen wir aber in Kenntnis der Unterschiede der Entwicklungskurven jene Produkotinsmenge, die die eine bzw. die andere Population in den einzelnen Zeitpunkten der Entwicklung der Individuen als Nahrung bieten kann, völlig anders auswerten.

Auf die Frage der materiellen Zusammensetzung der Organismen können die Insekten auch gute Beispiele liefern. In Tab. 1 ist der Fettgehalt einiger In-

Tabelle 2. Daten der Nahrungsaufnahme und der Verwertung der Nahrung verschiedener körnerfressender Vögel der Passeriformes im Falle der Konsumierung von Hirsenkörnern

Art	$\frac{C \times 100}{\text{Gewicht der Vögel}}$	$\frac{FU \times 100}{C}$	Untersuchungsergebnisse von
Taeniopygia guttata (Estrildidae)	21,70	14,85	GERE, 1973
Lonchura striata (Estrildidae)	21,68	14,06	GERE, 1974
Passer m. monianus (Ploceidae)	17,82	14,23	GERE, nicht publ. Angaben

C (Konsumtion) = abs. Trockengewicht der täglichen Nahrungsmenge
FU (Fäzes und Urin) = tägliche Menge (in abs. Trockengewicht) des Exkrements und Urins

sektenimagines zu sehen, wieder aufgrund einer literarischen Zusammenstellung Nr. 1 – 4 enthalten Lepidoptera mit sich nicht ernährenden, Nr. 5 – 6 mit sich ernährenden Imagines, Nr. 7 – 8 sind Orthopteren. Für die sich nicht ernährenden, männlichen Schmetterlingsimagines ist der ausserordentlich hohe Fettgehalt charakteristisch, der beim Fliegen als eine noch im Larvenstadium aufgespeicherte Energiequelle dient (GERE, 1964). Auch der Fettgehalt der Weibchen ist beträchtlich, doch weniger als der der Männchen und hängt von ihrer Bewegungsaktivität ab. Im Organismus der sich ernährenden Schmetterlinge können wir nur eine geringe Fettreserve finden, da ihr Energiebedarf von ihrer Nahrung gedeckt wird. Bei diesen ist der Fettgehalt der Weibchen verhältnismässig höher als der der Männchen und diesen Fettüberschuss bauen sie in ihre Eier ein. Der sich im Fettgehalt des Körpers zeigende Geschlechtsunterschied zeigt auch bei den Orthopteren einen ähnlichen Charakter, es scheint jedoch, dass prozentmässige Fettgehalt im Körper der Orthopteren in beiden Geschlechtern mehr ist, als in den vorangehenden. In der Ausgestaltung dieser Typen fielen über die Verwandtschaftsverhältnisse hinaus – ersichtlich – auch den Eigenartigkeiten der Lebensweise eine entscheidende Rolle zu. Das Feststehen dieser Typen wird auch von vielen anderen, hier nicht erwähnten Messergebnissen unterstützt.

Die relative Menge der Nahrungsaufnahme der winzigen, körnerfressenden Vögel der Passeriformes und die Verwertungsfähigkeit der Nahrung (die Proportion des Exkrements im Vergleich zur konsumierten Nahrung) scheint einen ähnlichen Typ zu zeigen. Hierauf lassen die bisherigen Untersuchungen schliessen. Tab. 2 zeigt die Angaben der adulten Exemplare von 3 Vogelarten (die in zwei Familien gehören). Im Interesse einer besseren Vergleichbarkeit hielt ich im Laufe der Versuche die Individuen aller drei Arten unter gleichen Verhältnissen (bei Zimmertemperatur), und ihre Nahrung waren ausschliesslich nur Hirsenkörner. Die Untersuchung des Stoff- und Energieumsatzes zahlreicher Tiere (Vögel) stösst an methodische Schwierigkeiten. Die auch hier ersichtlichen Ähnlichkeiten leisten schon deshalb eine Hilfe für die Produktionsbiologie, weil sie

aufgrund der an den leichter untersuchbaren Arten gemachten Beobachtungen solche Schlussfolgerungen ermöglichen, die sich auch auf die schwer untersuchbaren beziehen.

Eine Ähnlichkeit mit solchem Charakter, jedoch noch von weiterem Kreise ist auch bei den detritusfressenden Komponenten der Makrofauna des Bodens bekannt. In der Literatur finden sich reichlich Hinweise darauf, dass diese Tiere einen sehr beträchtlichen Teil ihrer Nahrung ihrem Exkrement zuführen. Ich selbst stellte fest, dass die zur konsumierten Nahrung ins Verhältnis gestellte Proportion des Exkrementes bei den mit etwa einjährigem, dunkelbraunem Eichenfallaub ernährten Diplopoden und Isopoden sich im allgemeinen über 90% befindet (im Gegensatz zu den Vögeln, wo dieser Wert – wie es weiter oben angegeben wurde – sich zwischen 14–15% bewegt; GERE, 1956 *b)*. Die relative Menge der Nahrungsaufnahme der mit ähnlichem Eichenfallaub ernährten Diplopoden und auch bei einer untersuchten Isopodenart war ziemlich gleich (GERE, 1965). Da die Individuen dieser Tiere von verschiedener Grösse die Nahrung nicht nach dem Verhältnis ihres Körpergewichtes, sondern in der Proportion der Änderung ihrer durch die 2/3-Potenz ihres Körpergewichtes annähern ausdrückbaren Körperfläche konsumieren, tritt die Ähnlichkeit noch mehr hervor, wenn wir ihre Nahrungsaufnahme nicht mit ihrem Körpergewicht, sondern zu dem Wert der 2/3-Potenz ihres Körpergewichtes (in diesem Falle ihres Trockengewichtes) in Verhältnis stellen. Den so gewonnenen Quotienten können wir VAN DER DRIFTsche Zahl (nach BALOGH, 1958) nennen (Tab. 3, Nr. 1–4). KURČEVA (1964) hat bei einer höheren Temperatur die Nahrungsaufnahme je einer Diplopoden-, Isopoden- und sogar Dipterenlarve für ähnlich gefunden (Tab. 3, Nr. 5–7). Auf diese Weise können auch solche Arten einen ähnlichen Typ vertreten, die hinsichtlich ihrer Nahrungsaufnahme systematisch voneinander ganz weit stehen.

Es ist interessant, dass die jenigen Tiere, die aus einer gewissen Nahrung in bestimmter Zeit verhältnismässig ähnliche Menge konsumieren, eine andere Nahrung in abweichender Menge zu sich nehmen können, sich also in diesem Falle schon als verschiedene Typen verhalten. Laut den Angaben Nr. 8–10 der Tab. 3 nehmen die oben erwähnten, sich aus dem morschen Xylem der Eiche ähnlich ernährenden Diplopoden ganz verschiedene Mengen zu sich. Aufgrund der bisherigen Untersuchungen scheint es jedoch, dass dies im Vergleich zu den oben erwähnten Fällen nur seltener vorkommt.

DUNGER (1958 *a)*, der hinsichtlich der Menge der Nahrungsaufnahme der Diplopoden und Isopoden vor allem die Unterschiede betonte, wies eine sehr interessante Kongruenz in der Verdauung dieser Tiere (DUNGER, 1958 *b:* 1960) nach. Er gab verschiedenen Bodentieren verschiedenes Fallaub und stellte fest, dass einerseits sich die chemische Zusammensetzung des Fallaubes während der Passage durch den Darmtrakt der Bodentiere nur wenig verändert, andererseits bei der Konsumierung von stickstoffreichen Blättern in der Humuskonzentration unabhängig von der Tierart eine geringe Zunahme zu verzeichnen ist, bei den stickstoffarmen Blättern hingegen eine schwache Huminsäureabnahme erfolgt. Einen Teil der sich auf den Huminsäuregehalt und den Farbquotienten der Nahrung und des Exkrementes beziehenden Angaben enthält Tab. 4. Die Ähnlichkeiten fallen auch hier ins Auge. „Die mit neun Blattarten in verschiedenen Altersstufen und neun Tierarten in über 100 Variationen durchgeführten Versuche ergaben ferner, dass alle untersuchten Tierarten grundsätzlich gleiche

*Tabelle 3. Menge der Nahrungsaufnahme von detritusfressenden Gliederfüsser des Bodens. (Daten der Nr. 1 – 4 und 8 – 10 nach Gere, 1965, die der Nr. 5 – 7 nach Kurčeva, 1974, * eigene Berechnung*

Nr.	Art	Nahrung	Temperatur (°C)	$\frac{C \times 100}{\text{Gewicht des Tieres}}$	$\frac{C}{\text{Gewicht des Tieres}^{2/3}}$
1	ad. *Chromatoiulus projectus* (Diplopoda)	überwintertes Eichenfallaub	10,5	1,78	0,20
2	ad. *Cylindroiulus boleti* (Diplopoda)	überwintertes Eichenfallaub	10,5	1,82	0,15
3	ad. *Polydesmus complanatus* (Diplopoda)	überwintertes Eichenfallaub	10,5	1,49	0,16
4	ad. *Protracheoniscus amoenus* (Isopoda)	überwintertes Eichenfallaub	10,5	2,66	0,15
5	ad. *Chromatoiulus rossicus* (Diplopoda)	überwintertes Eichenfallaub	sommerlich	4,49	0,49*
6	ad. *Tracheoniscus rathkei* (Isopoda)	überwintertes Eichenfallaub	sommerlich	5,95	0,47*
7	*Tipula scripta* (Diptera)	überwintertes Eichenfallaub	sommerlich	5,93	
8	ad. *Chromatoiulus projectus* (Diplopoda)	morsches Xylem	10,5	0,40	0,050
9	ad. *Polydesmus complanatus* (Diplopoda)	morsches Xylem	10,5	2,15	0,22
10	ad. *Cylindroiulus boleti* (Diplopoda)	morsches Xylem	10.5	5,12	0,40

C (Konsumtion) = abs. Trockengewicht der täglichen Nahrungsmenge
FU (Fäzes und Urin) = tägliche Menge (in abs. Trockengewicht) des Exkrements und Urins

Leistungen bei der Bildung bzw. Zerstörung von Huminstoffen im Darmtraktus zeigen" – schreibt der Verfasser (DUNGER, 1960). Eines soll noch hervorgehoben werden, dass die Gültigkeit dieser Feststellung auch auf *Retinella nitidula*, eine untersuchte Schneckenart beziehbar ist. Es liegt ausser Zweifel, dass wir in Kenntnis dieser Ähnlichkeiten die Rolle der Bodenfauna in der Mineralisation und Humifikation des Fallaubes leichter überblicken können.

Während ich betonen möchte, dass auch mehrere sonstige Beispiele dieser Typen erwähnt werden könnten, dürfen wir nicht ausser acht lassen, dass noch sehr viele, in diese Richtung unternommene Untersuchungen nötig sein werden,

Tabelle 4. Huminsäuregehalt und Farbquotient von verschiedenen, überwinterten Fallaubarten und des Exkrements der mit diesen ernährten Diplopoden und Isopoden (nach Dunger, 1958 b)

Art		Nahrung: Fallaub von			
		Alnus glutinosa	*Fraxinus excelsior*	*Acer platanoides*	*Quercus robur*
	a	9,9	7,5	5,9	10,3
	b	4,4	4,7	4,3	5,0
Cylindroiulus teutonicus (Diplopoda)	a	11,9	10,0	6,9	9,8
	b	4,5	4,6	5,6	4,9
Iulus scandinavius (Diplopoda)	a	11,6	10,0	6,3	9,8
	b	4,4	4,6	6,2	4,9
Glomeris connexa (Diplopoda)	a	13,6	9,1	6,0	9,6
	b	4,8	4,6	4,4	4,8
Armadillidium vulgare (Isopoda)	a	11,8	8,0	5,2	10,1
	b	4,8	4,3	5,4	5,2
Tracheoniscus rathkei (Isopoda)	a	10,6	9,4	5,1	10,3
	b	4,4	4,5	6,0	4,5
Porcellio scaber (Isopoda)	a	11,2	10,2	5,0	16,4
	b	4,3	4,9	4,8	5,1
Oniscus asellus (Isopoda)	a	11,4	9,2	4,6	10,9
	b	4,2	4,9	4,9	5,3

a = Huminsäuregehalt in % lufttrockener Substanz
b = Farbquotient Q 4/6

um eine weitere Anwendung der Typisierung zu ermöglichen. Es ist aber sicher, dass die Typisierung für die weiteren produktionsbiologischen Untersuchungen eine grosse Hilfe leisten wird.

Zusammenfassung

Aufgrund zahlreicher Angaben der Fachliteratur kann festgestellt werden, dass zwischen den verschiedenen Tierarten hinsichtlich der einen oder mehrerer vom produktionsbiologischen Gesichtspunkt aus wichtiger Eigenschaften oft eine Ähnlichkeit besteht. Die Ähnlichkeit kann sich auf die Wachstumsgeschwindigkeit des Gewichtes der Tiere, die Zusammensetzung der Körpersubstanzen, die Menge der Nahrungsaufnahme, die Qualität der Verdauung usw. erstrecken. Die Ähnlichkeit ist zwischen den verwandten Arten selbstverständlich häufiger zu beobachten, doch kann sie auch zwischen Arten bestehen, die systematisch voneinander weit liegen. Aufgrund der Ähnlichkeiten lassen sich die verschiedenen Tiere in ökologisch-produktionsbiologische Typen reihen. Durch die Typisierung kann vermieden werden, dass im Laufe der Untersuchung des Stoff- und Energieumsatzes der Ökosysteme die Erscheinungsformen (Semaphoronten) einer jeden Art einzeln untersucht werden müssen. Dies kann eine grosse Hilfe zu den zukünftigen produktionsbiologsichen Untersuchungen leisten.

SCHRIFTTUM

1. Balázs, A., Kováts, Z. & Burg, M. (1962): *Biochemical analysis of premortal involution process on aphagus imagines.* – Acta Biol. Hung., 13: 169–176.

2. Balogh, J. (1958): *Lebensgemeinschaften der Landtiere.* – Berlin und Budapest: 1–560.

3. Bauer, Z. (1975): *The biomass production of the tree sparrow, Passer m. montanus (L.) population in the conditions of the flood forest.* – Internat. Stud. Sparrows, 8: 124–139.

4. Domroese, K. A. & Gilbert, L. I. (1964): *The role of lipid in adult development and flight-muscle metabolism in Hyalophora cecropia.* – J. Exp. Biol., 41: 573–590.

5. Dunger, W. (1958 *a*): *Über die Zersetzung der Laubstreu durch die Boden-Makrofauna im Auenwald.* – Zool. Jb. Syst., 86: 129–180.

6. Dunger, W. (1958 *b*): *Über die Veränderung des Fallaubes im Darm von Bodentieren.* – Z. Pflanzenern., Düngung, Bodenkunde, 82: 174–193.

7. Dunger, W. (1960): *Zu einigen Fragen der Lesitung der Bodentiere bei der Umsetzung organischer Substanz.* – Zentralbl. f. Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, II. Abt., 113: 345–355.

8. Elton, C. (1927): *Animal ecology.* – London.

9. Gere, G. (1956*a*): *Investigations into the Laws Governing the Growth of Hyphantria cunea Drury Caterpillars.* – Acta Biol. Hung., 7: 43–72.

10. Gere, G. (1956 *b*): *The examination of the feeding biology of the humificative function of Diplopoda and Isopoda.* – Acta Biol. Hung., 6: 257–271.

11. Gere, G. (1964): *Change of weight, lipid and water content of Lymantria dispar L. with special regard to the chemical and energetic changes during insect metamorphosis and imaginal life.* – Acta Biol. Hung., 15: 139–170.

12. Gere, G. (1965): *Fütterungsversuche mit bodenbewohnenden Diplopoden und Isopoden in der Baradla–Höhle bei Aggtelek (Ungarn).* Opusc. Zool. Budapest, 5: 193–196.

13. Gere, G. (1973): *Die quantitativen Verhältnisse des Wasserhaushaltes und des Gesamtstoffumsatzes des Zebrafinken (Taeniopygia guttata Vieill.)* – Opusc. Zool. Budapest, 12: 63–72.

14. Gere, G. (1974): *Die quantitativen Verhältnisse des Wasserhaushaltes und des Gesamtstoffwechsels beim Japanischen Mövchen (domestizierte Form von Lonchura striata [L.]).* – Ann. Univ. Sci. Budapest., Sect., Biol., 16: 163–176.

15. Gere, G. (1977): *Über den Wasser- und Fetthaushalt der Imagines von Rhopalocera-Schmetterlingen.* – Opusc. Zool. Budapest, 15. (Im Druck).

16. Gyllenberg, G. (1969): *The energy flow through a Chortippus parallelus (Zett.) (Orthoptera) population on a meadow in Tvärminne, Finland.* – Acta Zool. Fenn., 123: 3–75.

17. Henning, W. (1950): *Grundzüge einer Theorie der phylogenetischen Systematik.* – Berlin: 1–370.

18. Janda, V. jr. (1958): *Celková látková přeměna hmyzu. VII. Spotřeba potravy během larválního vyvoje pilatky Trichiocampus viminalis Fall. (Gesamtstoffwechels der Insecten. VII. Nahrungsverbrauch bei der Blattwespe Trichiocampus viminalis Fall. während der larvalen Entwicklung.)* – Acta Soc. Zool. Bohemoslovenicae, 22: 137–147.

19. Janda, V. jr. & Marek, M. (1960): *Celková látková hmyzu. IX. Metabolismus kukel bekyně vrbové Leucoma salicis L. (Gesamtstoffwechsel der Insecten. IX. Stoffwechsel der Weidenspinnerpuppen (Leucoma salicis L.).* – Acta Soc. Zool. Bohemoslovenicae, 24: 271–279.

20. Kurčeva, G. F. (1964): *Wirbellose Tiere als Faktor der Zersetzung von Waldstreu.* – Pedobiologia, 4: 7–30.

21. Lipsitz, E. Y. & McFarlane, J. E. (1970): *Total lipid and phospholipid during the life cycle of the house cricket, Acheta domesticus (L)* – Comp. Biochem. Physiol., 34: 699–705.

22. Petrusewicz, K. & Macfadyen, A. (1970): *Productivity of terrestrial Animals. Principles and Methods.* IBP Handbook No. 13. – Abingdon, Berkshire: 1–190.

23. Szelényi, G. (1955): *Versuch einer Kategorisierung der Zoozönosen.* – Beiträge zur Entomologie, 5: 18–35.

Opusc. Zool. Budapest, XVI, 1–2, 1979

Quantitative Untersuchungen über die Makrofauna der Laubstreu in Zerreichen- und Hainsimsen-Eichen-Beständen des Bükk-Gebirges

Von

I. Loksa*

Abstract. In order to establish the quantitative proportions of populations the author used 25×25 mm soil samples. The object of the investigation was the populations of Oniscinea, Diplopoda, Chilopoda, Pseudoscorpionidea, Phallangiidea and Araneae.

Sampling was carried out in the months of April, July and October, 1974. It was established that the species composition of Luzulo – Quercetum association was poorer compared to the *Quercus cerris* forest, the same is revealed in production values too. The soil moss level of Luzulo-Quercetum ass. is the poorest in species and consequently the production value is also the lowest. The species composition of the Diplopoda population in the *Quercus cerris* forest differs to a certain degree from the similar stand selected for standard investigations in the Sikfőkút-Project. This difference may be explained by the higher altitude (570 – 650 m) and the greater quantity of precipitation.

Die potenzielle Verbreitung der Traubeneichen-(Zerreichen-)Bestände (Quercetum petraeae cerris) nimmt im Bükk-Gebirge (Ungarn) äusserst grosse Gebiete ein. Mit Zunehmen der Höhe wird das Vorkommen dieser Bestände immer mehr extrazonal, sie kommen hier meistens nur auf den S – SO – SW gelegenen Hängen vor.

Auf den seichtgründigen, saueren Böden, hauptsächlich auf Quarzitgestein sind die Hainsimsen-Bestände (Luzulo – Quercetum) anzutreffen. In diesen wird die Krautschicht stellenweise von der Schwarzbeere *(Vaccinium mytrillus)* in verschieden grosser Ausdehnung gebildet. Am Boden dieser Bestände bildet sich eine dichte Moos-Schicht aus, die der Bodentierwelt günstige Lebensverhältnisse ermöglicht.

Die beiden Bestände kommen in unmittelbarer Nähe voneinander vor, oder gehen ineinander über, so dass für vergleichende Untersuchungen günstige Gelegenheit geboten war. Die Zerreichen-Bestände sind aus forstwirtschaftlichem Gesichtspunkt die wichtigsten Waldbestände des Landes, die Hainsimsen-Beständen sind als Schutzwälder gegen Bodenerosion besonders bedeutend, so dass ihre Erforschung auch von zoologischer Seite erforderlich war.

* *Dr. Imre Loksa*, ELTE Állatrendszertani és Ökológiai Tanszék (Lehrstuhl für Tiersystematik und Ökologie der Eötvös-Loránd-Universität), 1088 Budapest VIII., Puskin u. 3.

Wie bereits vorausgehend bekannt gegeben, bilden die Untersuchungen des Zerreichen-Bestandes vom Untersuchungsprojekt „Sikfőkút" die Ausgangsbasis für weitere Untersuchungen und so auch für die vorliegende Arbeit (Székelyhidy & Loksa, 1978).

Das jetzige Untersuchungsgebiet liegt NO von der Stadt Eger, zwischen dem Malom-Berg und Imókő, 570–650 m über dem Meeresspiegel.

In jedem Bestand wurden je 10 Proben mit Ausmassen von 25×25 cm (1/16 m^2) ausgesiebt, und an Ort und Stelle manuel ausgelesen. Die Gewichtisbestimmungen erfolgten nach Austrocknem bei 104 °C.

Traubeneichen-(Zerreichen-)Bestände (Quercetum petraeae-cerris)

Diese Bestände sind auf dem Malom-Berg auf S–SW–SO-Hängen in grosser Ausdehnung anzutreffen. Die untersuchten Bestände sind ungefähr 60–80 Jahre alt, der Boden der drei Bestände ist podsolierter brauner Waldboden. Den Höhenlangen entsprechend kommt vereinzelt auch die Hainbuche vor. In der Krautschicht dominiert *Poa nemoralis* und stellenweise *Festuca heterophylla*. Aufgrund der Aufnahmen vom 19. April, 3. Juli und 8. Oktober konnten bezüglich der untersuchten Tiergruppen folgende Feststellungen gemacht werden.

Oniscinea. In den Proben konnten bloss zwei Arten nachgewisen werden, u. zw. *Porcellium collicola* und *Protracheoniscus amoenus*. Die erstere war ständig anzutreffen, maximale Abundanz auch so nur 8,0 /m^2, die letztere kam nur akzessorisch vor.

Diplopoda. In den Proben konnten 7 Arten angetroffen werden, u. zw. *Glomeris hexasticha, Heteroporatia bosniense, Polydesmus complanatus, Leptohyllum nanum, Leptoiulus proximus, Chromatoiulus projectus* und *Polyzonium germanicum*.

Von den angeführten Arten spielt bei der Zersetzung der Laubstreu zweifelohne die grossköperige Art *Chromatoiulus projectus* die grösste Bedeutung. Sie war stets anwesend. Obwohl in diesen Beständen ihre Individuenzahl nicht sehr hoch war, ihre Dominanz zwischen 7,84–19,34% schwankte, betrug die Gewichts dominanz 38,20–74,38%. In Tabelle 1 fassen wir die Abundanswerte pro m^2 in den drei Beständten (A B C), un deren Durchschnitt (Z), sowie den Durchschnitt der Zoomasse pro m^2 in mg angeführt, (P.) zusammen. Die römischen Zahlen geben den Zeitpunkt der Aufnahme-Monate an (April, Juli, Oktober). Diese Zeichenerklärung wird in Tabelle 1–4 beibehalten.

Tabelle 1. Chromatoiulus projectus

	A	B	C	Z	P
IV.	9,6	6,4	4,8	6,9	5630
VII.	6,4	4,8	4,8	5,3	2340
X.	8,0	9,6	11,2	9,6	3464

Die andere bedeutende Art war *Leptohyllum nanum*. Ihr Vorkommen weist auf Hainbuchen-Eichenwälder und Buchenwälder hin, in Zerreichen-Beständen

verleiht sie der Diplopoden-Gemeinschaft einen interessanten Charakter. Das massenhafte Auftreten in diesem Bestand lässt sich mit den von der Höhenlage bedingten klimatischen Verhältnissen des Standortes erklären. Ihre Abundanzwerte schwankten in den drei Beständen zwischen 36,8 – 65,6/m², die Dominanz innerhalb der Gruppe schwankte zwischen 65,74 – 82,45%. Da es sich um kleinkörperige Tiere handelt, betrug die Gewichtsdominanz innerhalb ihrer Gruppe nur 11,45 – 24,63%. Obwohl es sich um kleine Tiere handelt, spielen sie vermutlich in der Zersetzung der Laubstreu eine bedeutende Rolle, doch liegen uns bisher diesbezügliche Angaben nicht vor.

Tabelle 2. Leptophyllum nanum

	A	B	C	Z	P
IV.	36,8	43,2	40,0	40,0	1084
VII.	65,6	54,4	59,4	59,2	1196
X.	49,6	51,2	46,4	49,0	1098

Die im Juli erscheinende *Heteroporatia bosniense* und die übrigen Diplopoden-Artee sind ständige Elemente, die Werte ihrer Charakteristika sind jedoch niedring.

Chilopoda. In den Proben konnten 11 Arten nachgewiesen werden, u. zw. *Lithobius forficatus, L. mutabilis, L. muticus, L. pusillus, Monotarsobius aeruginosus, Scolioplanes transsylvanicus, Henia illyrica, Schendyla nemorensis, Brachyschendyla montana, Clinopodes flavidus* und *Geophilus proximus.*

Zwei Lithobiomorpha-Arten, *Lithobius mutabilis* und *L. muticus,* sowie die mit etwas niedereren Abundanzwerten vertretene *Monotarsobius aeruginosus* spielen als räuberische Elemente in der Streuschicht dieser Bestände die grösste Rolle.

Die Abundazwerte von *L. mutabilis* schwankten in den drei Beständen zwischen 49,2 – 108,8, Dominanz innerhalb der Gruppe betrug 61,35 – 67,52%. Minimum der Gewichtsdominanz innerhalb der Gruppe 36,33% maximum 68,36%. Sie ist die kennzeichnende, in Mengen auftretende Art, der in dem Bükk-Gebirge vorkommenden Varianten der Zerreichen-Bestände.

Tabelle 3

	A	B	C	Z	P
IV.	65,6	56,0	49,2	56,9	1490
VII.	108,8	70,4	57,6	78,9	2456
X.	76,8	81,6	67,2	75,2	2028

Die Abundanzwerte von *L. muticus* schwankten in den drei Beständen zwischen 22,4 – 43,2/m², die Dominant innerhalb der Gruppe zwischen 19,96 – 24,34

%. Die Gewichtsdominanz innerhalb der Gruppe betrug 20,28 – 23,46%. Sie ist eine allgemein verbreitete Art, scheint an keinen Bestand gebunden zu sein. In vielen Varianten der Zerreichen-Bestände, wie z. B. auch in den Budaer-Bergen, ist sie die alle in vorherrschende Art.

Tabelle 4

	A	B	C	Z	P
IV.	27,2	24,0	22,4	24,5	880
VII.	38,4	30,4	43,2	37,3	946
X.	32,0	36,8	40,0	36,2	912

Von den Geophilomorphen schwankten die Abundanzwerte von *Clinopodes flavidus* in der Streuschicht zwischen 3,2 – 22,4/m². Diese Zahl widerspeigelt je doch nicht das wahrhaftige Verbreitungsbild dieser Art, da sie nur gelegentlich in der Streuschicht auftauchen, ansonst sich in verschiedenen Tiefen des Bodens aufhalten; diese Feststellung bezieht sich übrigens auf die meisten Geophilomorphen.

Die übrigen Arten wurden ebenfalls regelmässig angetroffen, eine höhere Individuendichte erreichte nur *Schendyla nemorensis* und *Geophilus proximus* (1,6 – 9,6/m²).

Von den Weberknechten (Phallangiidea) kamen nur drei Arten in den Proben vor, u. zw. *Platybunus triangularis, Trogulus tricarinatus* und *Phallangium opilio*. Ihre Individuendichte war jedoch sehr niedrig.

Die Pseudoskorpioniden (Pseudoscorpionidae) waren ebenfalls mit drei Arten vertreten, u. zw. *Roncus lubricus, Neobysium erythrodactylum, N. sylvaticum*. Die Individuendichte von *N. erythrodactylum* schwankte zwischen 4,8 – 17,6 pro m², während die der anderen beiden Arten nie über 3,2 pro m² betrug.

Die Spinnen (Araneae) waren in den Proben mit 18 Arten vertreten. Es sind dies die folgenden: *Coelotes inermis, Trochosa terricola, Centromerus silvaticus, Microneta viaria, Sidera gracilis, Leptyphantes pallipes, Panamomops mengei, Ceratinella major, Wideria antica, Tapinocyba insecta, Micrargus herbigradus, Robertus arundineti*, Micryphantidae spp. j., *Clubiona compta, C. terricola, Clubiona* sp. juv., *Haplodrassus silvestris, Neon reticulatus*.

Von den äusserst zahlreichen Spinnen-Arten, zeigte keine Art eine hervorspringende Dominant. Eine beinahe ständige hohe Individuendichte wies *Tapinocyba insecta* auf, (4,8 – 17,6 pro m²), in einigen Fällen erreichte auch *Sidera gracilis* und *Clubiona compta* Individuenwerte von 9,6/m². Bezüglich der Gewichtsdominant erreichten *Coelotes inermis* und *Trochosa terricola* innerhalb der Gruppe Werte von 30,84 – 50,68% (Gewichtsdominanz zusammen also über 80%).

Die Ameisen (Formicidae) waren mit 4 Arten vertreten, u. zw.: *Leptothorax tuberum, Myrmica ruginodis, Stenamma westwoodi, Lasius brunneus*. Die maximale Individuendichte der ersten Art betrug 156,8/m², die der zweiten 147,2/m². Kennzeichnend für die klimatischen Verhältnisse der Best nde war der Umstand dass bereits am 8. Oktober keine aktive Ameise angetroffeän werden konnte.

Hainsimsen-Eichen-Bestände (Luzulo-Quercetum)

Die untersuchten Bestände liegen auf dem in NW-Richtung liegendem Kamm des Imókő, bzw. an dessen Seite, auf Quarzitgestein. Der I. Bestand besitzt eine SW-Exposition, Abdachungswinkel 20–25°; *Luzula albida* kommt massenhaft vor, aber auch *Poa nemoralis* ist häufig anzutreffen, während *Vaccinium* vollkommen fehlt; der Bestand kann als Übergang zum Zerreichen-Bestan betrachtet werden. Im II. Bestand kommt *Luzula* in Flecken vor, *Vaccinium myrtillus* ist niedrig, bildet bürstenförmige Sträucher; besitzt eine gut entwickelte, zusammenhängende *Dicranum*-Moos-schicht. Der III. Bestand ist ebenfalls von Plakor-Lage, biegt aber in NO-Richtung, *Luzula* sehr häufig, *Vaccinium* fehlt. *Dicranum*-Moospölster bedecken den Boden in 60–70%.

Die Untersuchungsperioden stimmen mit denen der Zerreichen-Bestände überein, im Juli wurden Proben auch aus den Moospölstern entnommen.

Oniscinea. In den Proben konnte bloss eine Art angetroffen werden, ihre Abundant schwankte zwischen 3,2–27,2/m². Im Moos-Fazies war die Individunedichte im Juli nur 3,2–4,8 pro m².

Diplopoda. Es konnten bloss 5 Arten nachgewiesen werden, u. zw. *Heteroporatia bosniense, Leptophyllum nanum, Leptoiulus proximus, Chromatoiulus projectus* und *Polyzonium germanicum.* Im Moos-Fazies konnte nur *Heteroporatia bosniense* mit einer Individuendichte von 6,4–8,0 pro m² angetroffen werden.

Heteroporatia bosniense erschien in den drei Beständen im Juli mit einer Individuendichte von 25,6–43,2 pro m². Die Gewichtsdominant der juvenilen Tiere betrug innerhalb der Gruppe 7,68–23,96%, die Zoomasse 365–518 mg/m². Im Oktober stiegen diese Werte ungewöhnlich an; es ist anzunehmen, dass die ganz kleinen Tiere, die im Juni entschlüpfen, im Juli beim manuellen Auswählen übersehen wurden. Die Abundanz der entwickelten Tiere im Oktober schwankte zwischen 54,4–192,0 pro m², Gewichtsdominanz innerhalb der Gruppe betrug 42,73–78,43%, die Zoomasse 2285–8064 mg/m².

Leptophyllum nanum trat nur im I. Bestand mit einer bedeutenderen Abundanz auf (3,2–27,2/m²), in den beiden anderen Beständen schwankte die Individuendichte zwischen 1,6–4,8/m². In den Moosproben fehlte diese Art.

Die Abundanz von *Chromatoiulus projectus* gestaltete sich zwischen 1,6–11,2 pro m², die Gewichtsdominanz innerhalb der Gruppe betrug 19,56–75,47%, die Zoomasse 864–3584 mg/m². Im Moos fehlte diese Art. Die beiden anderen Diplopoden-Arten kamen akzessorisch vor.

Chilopoda. In den Proben kamen 10 Arten vor, es sind dies die folgenden: *Lithobius forficatus, L. mutabilis, L. muticus, Monotarsobius aeruginosus, Scolioplanes transsylvanicus, Henia illyrica, Schendyla nemorensis, Brachyschendyla montana, Clinopodes flavidus, Geophilus proximus.*

Die Individuendichte von *Lithobis muticus* schwankte zwischen 8,0–22,4 pro m² in den drei Beständen. Die Gruppendominanz betrug 40,00–58,33%, Gewichtst 11,35–39,52%, die Zoomasse 360–506 mg/m.² In den Moos-Proben betrug die Individuendichte 9,6–12,8/m². Eine bedeutende Individuendichte erreichte von den vier Lithobiomorphen noch *Monotarsobius aeruginosus* (1,6–6,4/m²), doch muss erwähnt werden, dass sie nicht in allen Aufnahmen vorkam. Im Moos erlangte sie eine Individuendichte von 9,6–11,2/m².

Sämtliche Geophilomorphen-Arten konnten ständig angetroffen werden, die höchsten Charakteristika-Werte erreichte *Clinopodes flavidus* (3,2–27,2/m²).

Bezüglich der Arten wird auf die in den Zerreichen-Beständen ausgesagten hingewiesen.

Von den Weberknechten konnte nur eine Art, *Phallangium opilio* angetroffen werden; ihr Vorkommen ist akzidental.

Die Pseudoskorpionen (Pseudoscorpionidae) waren mit zwei Arten vertreten: *Roncus lubricus* und *Neobysium erythrodactylum*. Die Individuendichte der letzteren schwankte zwischen 1,6 – 17,6, in den Moosproben zwischen 1,6 – 3,2 pro m^2.

Von den Spinnen (Araneae) konnten 16 Arten in den Proben nachgewiesen werden, es sind dies die folgenden: *Altella* sp. juv., *Coelotes inermis, Trochosa terricola, Lepthyphantes flavipes, Micronela viaria, Ceratinella major, Panamomops mengei, Tapinocyba insecta, Meioneta rurestris,* Micryphantidae spp. jj., *Robertus arundineti, Zodarion germanicum, Clubiona compta, Drassodes silvestris, Xysticus cambridgei, Oxyptila praticola.* Eine bedeutendere Individuendichte erreichte in allen Beständen *Trochosa terricola* (3,2 – 12,8/m^2) und *Micronela viaria.* Übrigens kommen beinahe dieselben Charaktere wie im Zerreichen-Bestand zum Ausdruck, z. B. die Dominanz- und Gewichtsdominanz-Verhältnisse von *Coelotes inermis* und *Trochosa terricola.* Die Gemeinschaft der Spinnen in den Moos-Proben gestaltete sich im Juli sehr spärlich, es konnten nur juvenile Individuen aus der Familie Micryphantidae (4,8 pro m^2) und *Oxyptila praticola* nachgewiesen werden (6,4 pro m^2).

Von den Ameisen (Formicidae) wurden 5 Arten in den Proben angetroffen, u. zw. *Leptothorax tuberum, Myrmica ruginodis, Myrmecina graminicola, Stenamma westvoodi* und *Lasius brunneus.* Eine grössere Abundanz erreichte nur *Leptothorax tuberum* (41,6 – 118,4/m^2). Diese und *Myrmica ruginodis* konnten auch im Oktober erbeutet werden, wenn auch nur mit einer Individuendichte von 1,6 – 6,4 pro m^2. In den Moosproben konnten nur die drei ersten der weiter oben angeführten Arten nachgewiesen werden. *Leptothorax tuberum* besass eine Abundanz von 40,0 – 99,2 pro m^2.

Vergleich der beiden Gemeinschaften

Wie aus den bisher angeführten hervorgeht, und wie auch allgemein bekannt, können nur solche Tiergruppen miteinander verglichen werden, die in entsprechender Individuenzahl in den einzelnen Beständen auftreten und die nahezu ständig – abgesehen von den Wintermonaten, in aktivem Zustand anzutreffen sind. Solche sind in erster Linie die Vertreter der Oniscinea-, Diplopoda- und Chilopoda-Gruppen. Ein ausführlicherer Vergleich wird eben deswegen mit diesen vollzogen.

Tabelle 5 enthält sämtliche Arten, die während der Untersuchungen in den 6 Beständen und in den Moosproben (im Juli) nachgewiesen werden konnten. Die erste Kolumne der tabelle (A, B, C) bezieht sich auf die Arten der Zerreichen – Bestände, die zweite Kolumne (I, II, III) auf die Hainsimsen-Bestände und die dritte Kolumne (IIa, IIIa) auf den Moos-Fazies der Hainsimsen-Bestände. (Von den beiden letzteren sind nur Aufnahmen aus dem Juli vorhanden.) Die Angaben beziehen sich auf die im Juli festgestellten Abundnazwerte pro m^2. Die Zeichen + bedeuten, dass die Tiere im April und Oktober oder in beiden Monaten vorkamen, – dass sie nicht vorkamen.

Der aufgrund der Tabelle 5 berechnete Artidentitätsindex gestaltet sich im Monat Juli, wie folgt:

A	B	C	I	II	III	IIa	IIIa	
100,0	58,8	60,0	41,6	42,8	50,0	25,0	33,3	A
	100,0	55,5	41,1	58,8	64,7	29,4	35,7	B
		100,0	40,0	41,2	38,8	26,6	33,3	C
			100,0	70,0	63,6	71,3	62,5	I
				100,0	90,9	50,0	60,0	II
					100,0	45,4	54,5	III
						100,0	83,3	IIa
							100,0	IIIa

Aus dem einmaligen Vergleich der Bestände geht hervor, dass die einzelnen Bestände der Zerreichen und Hainsimsen – Eichen-Beständen eine hohe Artidentität besteht, während im Moos-Fazies dies nicht der Fall ist.

Wenn die Artidentität des gleichen Monates, durch Zusammenziehen der einzelnen Bestände berechnet wird, so erhalten wir folgenden Index:

A – C	I – III	IIa – IIIa	
100,0	55,5	30,0	A – C
	100,0	54,5	I – III
		100,0	IIa – IIIa

Die Indexe weisen eindeutig darauf hin, dass die Artidentität in den beiden Beständen sehr hoch ist, von dem Moos-Fazies sich aber absondern, zwischen den streubedeckten Teilen und der Moos-Schicht ist die Identität wieder gross. Die aus den Angaben der drei Aufnahmen berechnete Artidentität im Zerreichen- und Hainsimsen-Eichen-Bestand beträgt 75%.

Wenn bloss die Artidentität berücksichtigt wird, könnte die Folgerung gezogen werden, dass hinsichtlich der Makrofauna der beiden Bestände keine wesentlichen Unterschiede bestehen. Im Grunde genommen verfügen die Hainsimsen-Bestände über eine verarmte Fauna eines Zerreichenbestandes. Sämtliche Tiergruppen berücksichtigend, kann festgestellt werden, dass die Zahl derjenigen Arten die nur in einem oder anderem Bestand vorkommen (es sind nur die akzessorischen Elemente) sehr gering ist.

Wenn die beiden Bestände und der Moos-Fazies des Hainsimsen-Bestandes aus dem Gesichtspunkt der Individuendichte (Abb. 1) oder der Zoomasse (Abb. 2) verglichen wird, so fallen die hohen Werte im Zerreichen-Bestand sofort auf, während diese im Hainsimsen-Eichen-Bestand niederer und im Moos-Fazies am niedrigsten sind. Ohne weitgehende Folgerungen daraus ziehen zu können, lassen sich im gegebenen Falle Paralelle mit dem Bodenzustand und dem Holzertrag der beiden Bestände machen.

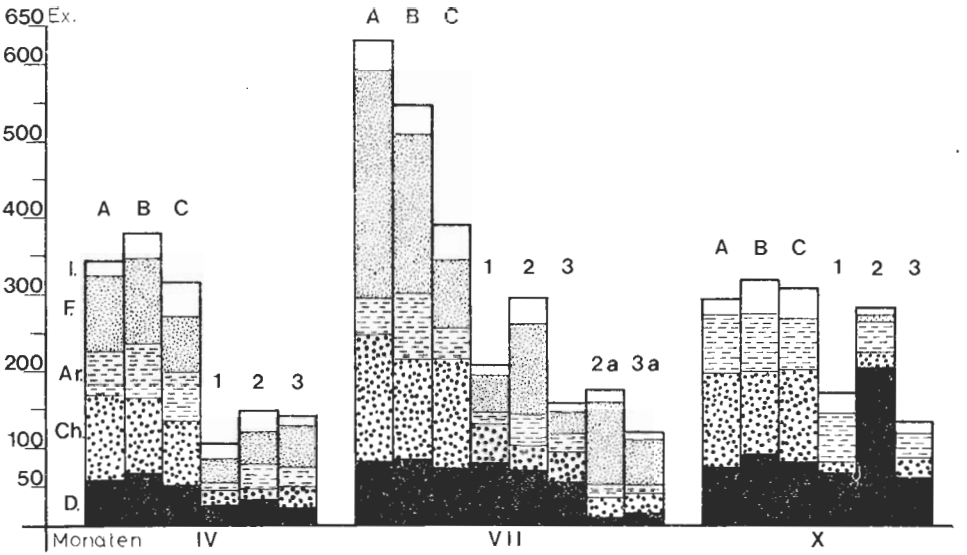


Abb. 1. A/m²-Verhältnisse der streuschichtbewohnenden Makrofauna in den acht untersuchten Waldbeständen. *A, B, C:* Zerreichen-Bestände; *1, 2, 3:* Hainsimsen-Eichen-Bestände; *2a, 3a:* Moosfazies der Hainsimsen-Eichen-Bestände; *D:* Oniscoideen und Diplopoden; *Ch:* Chilopoden; *Ar:* Phalangiideen, Pseudoscorpionideen und Araneideen; *F:* Formiciden; *I:* Insektenlarven

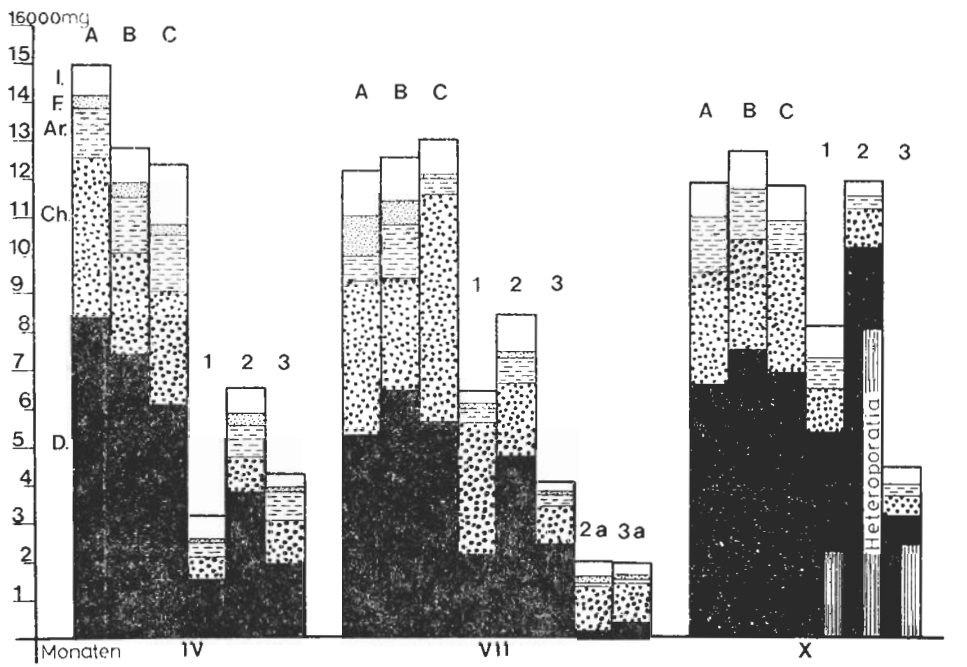


Abb. 2. P/m²-Verhältnisse in den acht untersuchten Waldbeständen. (Erklärung siehe bei Abb. 1)

SCHRIFTTUM

1. Balogh, J. (1958): *Lebensgemeinschaften der Landtiere.* – Budapest – Berlin, 1 – 560.
2. Dudich, E., Balogh, J. & Loksa, I. (1952): *Produktionsbiologische Untersuchungen über die Arthropoden der Waldböden.* – Acta Biol. Hung., 3: 295 – 317.
3. Loksa, I. (1966): *Die bodenzoozönologischen Verhältnisse der Flaumeichen – Buschwälder Südostmitteleuropas.* Budapest, 1 – 437.
4. Loksa, I. (1968): *Quantitative Makrofauna-Untersuchungen in den Waldböden des Bükkgebirges (Ungarn).* Ann. Univ. Sci. Budapest, 9 – 10: 265 – 289.
5. Székelyhidy, E. & Loksa, I. (1978): *Oniscoiden-, Diplopoden- und Chilopoden-Gemeinschaften im Untersuchungsgebiet „Sikfőkut-Project" (Ungarn).* Opusc. Zool. Budapest, 15:00 – 00.

Tabelle 5. (Vergleichende Tabelle)

Spezies	A	B	C	I	II	III	IIa	IIIa
Oniscinea + Diplopoda								
Porcellium collicola	4,8 +	8,0 +	4,8 +	8,0 +	27,2 +	17,6 +	3,2	4,8
Protrachoniscus amoenus	– – – +	1,6 +	1,6 +	– – – –	– – – –	– – – –	– – –	– – –
Glomeris hexasticha	1,6 +	3,2 +	4,8 +	– – – –	– – – –	– – – –	– – –	– – –
Heteroporatia bosniense	– – – +	3,2 +	– – – +	43,2 +	30,4 +	25,6 +	6,4	8,0
Polydesmus complanatus	– – – +	– – – +	1,6 +	– – – –	– – – –	– – – –	– – –	– – –
Leptophyllum nanum	65,6 +	57,6 +	54,4 +	27,2 +	1,6 +	3,2 +	– – –	– – – – – –
Leptoiulus proximus	6,2 +	1,6 +	– – – +	– – – +	– – – +	1,6 +	– – –	
Chromatoiulus projectus	6,4 +	4,8 +	4,8 +	1,6 +	11,2 +	8,0 +	– – –	– – –
Polyzonium germanicum	– – – +	3,2 +	– – – +	– – – –	– – – –	– – – +	– – –	– – –
Chilopoda								
Lithobius forficatus	– – – +	– – – +	1,6 +	– – – –	– – – –	– – – –	– – –	– – –
Lithobius mutabilis	108,8 +	70,4 +	57,6 +	– – – +	– – – –	– – – –	– – –	– – –
Lithobius muticus	38,4 +	20,4 +	43,2 +	22,4 +	12,8 +	19,2 +	12,8	9,6
Lithobius pusillus	– – – +	– – – +	1,6 +	– – – –	– – – –	– – – –	– – –	– – –
Monotarsobius acruginosus	12,8 +	8,0 +	12,8 +	1,6 +	6,4 +	4,8 +	11,2	9,6
Scolioplanes transsylvanicus	– – – +	1,6 +	– – – +	– – – +	3,2 +	1,6 +	– – –	– – –
Henia illyrica	– – – +	1,6 +	– – – +	– – – +	1,6 +	3,2 +	– – –	– – –
Schendyla nemorensis	3,2 +	4,8 +	1,6g +	– – – +	1,6 +	1,6 +	– – –	3,2
Brychyschendyla montana	– – – +	3,2 +	– – – +	– – – +	– – – +	– – – +	– – –	– – –
Clinopodes flavidus	– – – +	11,2 +	22,4 +	27,2 +	6,4 +	8,0 +	3,2	4,8
Geophilus proximus	3,2 +	1,6 +	3,2 +	– – – +	– – – –	– – – –	– – –	– – –

A Contribution to the Knowledge on the Species of the Genus Coproica Rondani, 1861 (Diptera: Sphaeroceridae)*

By

L. Papp**

Abstract. Descriptions of two new species of the genus *Coproica* Rond. *(C. coreana* sp. n., *C. ghanensis* sp. n.), lectotype designations of *C. digitata* (Duda) and *C. pseudolugubris* (Duda, as well as many new locality data of other nine species are given relying on the sphaerocerid material of the Hungarian Natural History Museum.

Continuing to report on the materials of Sphaeroceridae preserved in the Zoological Department of the Hungarian Natural History Museum, the author discusses the species of the genus *Coproica* Rondani, 1861 in the present paper. The *Coproica* species are relatively well-known. The descriptions of the species dating from the last century were revised by Duda (5), on that occasion and also later he described new species (5, 6, 7); eventually, he also compiled the monograph of the Palaearctic species (8). In recent times Collin (4) and Richards (14) contributed valuable data to our knowledge on the species in question. Richards (14) also drew up a taxonomical key covering all species of the genus described up to 1960. Data about the range and way of life of the *Coproica* species are also to be found in the works of numerous other authors (bibliographic data of these works see: Duda, 8; Richards, 14 and Papp, 11.

In the Hungarian Natural History Museum a quite numerous material has accumulated from the collections cunducted by the Department of Systematic Zoology and Ecology of the Eötvös Loránd University and by the research workers of the Museum (1, 2, 3, 9, 12, etc.). A material of several thousand specimens is in question here even if one leaves the ten thousands of imagoes collected in the course of manure-ecological research out of account. The larvae and imagoes of most *Coproica* species are coprophagous. Certain species (in the first place *C. ferruginata* and *C. vagans*) live in vast numbers of individuals in all countries

* Sphaeroceridae (Diptera) in the collection of the Hungarian Natural History Museum, Part III.

** *Dr. László Papp*, Természettudományi Múzeum Állattára (Zoological Department of the Hungarian Natural History Museum), 1088 Budapest VIII., Baross u. 13.

where stock-breeding has reached an advanced stage; in one stable several thousands, in one manure plant millions of individuals are to be found. In view of their way of life, man has contributed to spreading certain *Coproica* species in a considerable degree. Thus *C. ferruginata*, *C. hirtula* and *C. vagans* have become cosmopolitic or neraly cosmopolitic. From recent data (see PAPP, 12) it seems that also *C. acutangula* and *C. hirticula* are spreading intesively. The other group of the *Coproica* species develops in the droppings of domestic and wild ungulates *(C. coreana* sp. n., *C. digitata*, *C. dentata*, *C. ghanensis* sp. n., *C. lugubris*, *C. pseudolugubris)*. In spreading these man has a minor part or none at all. Still, as shown by the example of the species *acutangula* ZETT. (a species living primarily in horse droppings), later also one or two of these may appear rather far beyond known up to now.

In our material I found 13 species, out of these 2 are new to science. From among the type-specimens of two species to be found in our Collection I designated lectotypes. I present the species in alphabetical order. The new data as to the range I marked by an asterisk following the name of the country in question.

Coproica acutangula (ZETTERSTEDT, 1847)

Hungary: 39 ♂, 28 ♀ pinned specimens, over 300 specimens, in alcohol from different localities. – Jugoslavia: 1 ♂: Novi, KERTÉSZ, 11. 7. 1900., *„acutangula* ♂" det. O. Duda; 3 ♂, 2 ♀: Zimony, KERTÉSZ, 22. 7. 1901; 2 ♂, 2 ♀, Zabljak, mon., 5. 7. 1958, Podgora, 1400 m, leg. MIHÁLYI. – Romania: 4 ♂, 1 ♀: Csíkszépvíz, FODOR, Vörösláz, 1009 m, 6. 7. 1917.; 2 ♂: Gyilkos tó, SZIL., 22. 8. 1931.; 3 ♂, 1 ♀: Homoródfürdő, SZIL., 22. 7. 1931. – Bulgaria: 1 ♂, 3 ♀: Varsec, 1–10. 8. 929, leg. SZILÁDY. – France: 1 ♂: Ft. Rambouillet, 29. 7. 10. *„Limosina pusilla* sec. typ. MEOG. ♂", det Dr. VILLENEUVE, *„acutangula"* det. O. DUDA; 1 ♀: ibid., 17. 8. 10., *„pusilla* ♀ (trés probablement)" [handwriting of? VILLENEUVE]. – USSR: 1 ♂, 1 ♀: Rossia, Kasan, 2–6. 6. [18]98. Exp. Zichy, leg CSIKI, *„Heteroptera acutangula* ZETT." det. KERTÉSZ. – Mongolia: 250 ♂, 147 ♀: see PAPP (11). – Afghanistan: 1 ♀ (PAPP (12)]. Other known distribution: N. America, Hawaii, Madeira, Zaire.

Coproica coreana sp. n.

Dark brown species, legs reddish brown; knees, ventral side of fore coxae and tarsi reddish yellow. Genae comparatively wide, longest diameter of eyes only 3 times longer than smallest genal width. Five pairs of moderately long interfrontals. Vibrissae comparatively short but thick. Third antennal joint and arista with short pubescence only. Thoracic chaetotaxy as in its congeners. Disc of scutellum with about 16 uniformly short bristles. Two short sternopleurals on each side (anterior not shorter than posterior, length about 0.04 mm). Legs normal, males without ventral hooks or other modifications on fore and hind metatarsi. Chaetotaxy of mid tibia: anterodorsals: at 1/4 and 7/12, a robust long bristle at 3/4; posterodorsals: a medium-sized bristle at 1/2 and a robust one at 3/4; a moderately long subventral bristle at 7/12 of tibia. Mid metatarsus (Fig. 1) with a very strong subbasal ventral bristle and 4–5 rather short and unpaired bristles. Wings clear, comparatively short and rounded. Wing measurements of holotype male: 1.12×0.51 mm, of paratypes: 1.12–1.45×0.46–0.66 mm. Costa ends at wing apex, with only moderately long thin bristles on $mg_1 \cdot c_x = 0.86-0.92$. r_{2+3} ending at a moderately sharp angle in c, r_{4+5} ending rather near to wing apex, its apical fourth curving down. $t_a\text{-}t_p/t_p = 1.42-1.44$. Hind lower edge of

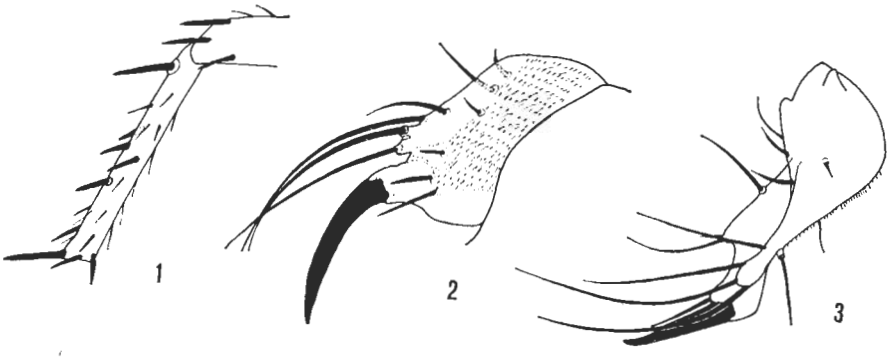


Fig. 1 – 3. *Coproica coreana* sp. n. *1:* lateral view of mid metatarsus; *2:* male surstylus in profile; *3:* surstylus in ventral view

discal cell only a little more than 90°. Anal vein angularly sinuate. Halteres light brownish yellow. Male hypopygium with 3 pairs of long and strong and with some shorter bristles. Surstylus (Fig. 2 and 3) with a very big, black, ventrally and slightly medially directed thorn and with some very long bristles. Female cercus with 2 long, wavily bent bristles and some short hairs.

Body length: holotype male: 1.72 mm, paratypes: 1.45 – 2.08 mm.

Holotype: male: Korean People's Republic, Prov. South Pyongan, Changlyong san, 50 km N of Pyongyan and 15 km E from Sa-gam, 13. 8. 1971, netting-from cow-pats, leg. S. HORVATOVICH and J. PAPP (No. 172). Paratypes: 1 ♂, 2 ♀: data same as for holotype. All type specimens preserved in alcohol in HNHM.

Coproica coreana sp. n. keys out in RICHARDS' (14) key to *hirtuloidea* (DUDA, 1925) (Peru, Bolivia), as it has a moderately long posterodorsal bristle at about the middle of mid tibia, but its mid metatarsus has a very strong subbasal ventral bristle. Its nearest relative is (in all probability) *C. dentata* L. PAPP, 1973. Contrarily to dentata, *C. coreana* sp. n. has no ventral projection on male mt_3, its $t_a - t_p$ is distinctly longer than t_p, and male surstyli (Fig. 2,3) widely differ in form and armature from those of dentata [cf. PAPP (11)].

Coproica dentata L. PAPP, 1973

Mongolia: holotype male, 181 ♂, 173 ♀ paratypes [see PAPP (11).] – Hungary: 55 ♂, 45 ♀ paratypes: Csévharaszt, borókás, lótrágyáról (= juniper grove, on horse droppings), 9. 8. 1972, leg. BAJZA & PAPP. (1 ♂, 1 ♀ paratypes now in Museum f. Naturkunde, Berlin, and 1 ♂ paratype in Eberswalde as exchange materials); 1 ♂ pinned and 3 specimens in alcohol: Dömsöd, Apajpuszta, on horse droppings, 6. 9. 1973, BAJZA & PAPP L.

Coproica digitata (DUDA, 1918)

Limosina (Coprophila) digitata DUDA, 1918: Abh. zool.-bot. Ges. Wien, 10/1: 209.

Lectotype male. 1.55 mm. Dark brown, subshining species with some grey pruinosity. Facial plate greyish yellow, genae yellowish grey. Eyes big, longest

diameter a little more than four times longer than smallest genal width. Four pairs of moderately long but rather thin interfrontals. Arista only 2.7 times longer than antenna. Mesonotal and scutellar bristles as in its congeners. One very small anterior and one small posterior sternopleural. Coxae greyish yellow, all other parts of legs greyish dark brown (sometimes also fore knees and parts of tarsi greyish yellow). Chaetotaxy of mid tibia: anterodorsals: at 7/32 and at 17/32 moderately long, at 3/4 very strong bristle; posterodorsals: at 1/4 and 1/2 small, at 23/32 a robust bristle; one small subventral bristle at about 7/12 of tibia. Mid metatarsus with 6 pairs of short bristles ventrally, without any characteristic bristles. Male hind metatarsus with a very big ventral projection. Wings light grey, veins light brown. Wing measurements of lectotype male: 1.22×0.54 mm. $c_x = 1.63$. Costa ends at wing apex, with moderately long bristles on mg_1; r_{4+5} straight, ending about as far from wing apex as vein m. Hind lower angle of discal cell about $90° \cdot t_a - t_p = 1.53$. Anal vein angularly sinuate. Halteres yellow. Abdomen relatively very long, tergites with very long lateral bristles. Male hypopygium with 3 pairs of long and thick, as well as with several moderately long bristles. Inner geitalia of lectotype not studied.

Lectotype male: Novi, KERTÉSZ – 11. 7. 1900. [on lower side of the label, KERTÉSZ's handwriting] – *"digitata* ♂" [DUDA's handwriting], det. O. DUDA (Hungarian Natural History Museum).

Paralectotypes (Museum für Naturkunde, Zoologisches Museum, Berlin): 1 ♂: Luxor, 44511, XII. – *digitata* ♂ det. DUDA [both labels from BECKER's collection); 1 ♂: Tunisia, Saint Germain, 28. 4. 1913. [a printed label] – *Heteroptera digitata* D. ♂ d. DUDA. Typus [DUDA's handwriting; from DUDA's collection). The type series consisted of two other specimens, one from Semlin, one from Novi. They were in our Collection, but got lost somehow. (In all probability they were destroyed by *Anthrenus* larvae during the time when our Sphaeroceridae, Asteiidae, etc. were lent to late Dr. M. P. ARADI.)

Other specimens in the HNHM: Hungary: 50 ♂, 35 ♀ from different localities. – Romania*: 1 ♂, 1 ♀: Homoródfürdő, SZIL., 22. 7. 1931. – Jugoslavia: 2 ♂, 2 ♀: Zabljak, Mont., 5. 7. 1958, Podgora, 1400 m, leg. MIHÁLYI. – Bulgaria: 12 ♂, 5 ♀: Varsec, 1–10. 8. 929, leg. SZILÁDY. – Afghanistan: see PAPP (12). Other known occurrence: Egypt.

Coprоica ferruginata (STENHAMMAR, 1854)

Hungary: 276 ♂, 201 ♀ pinned specimens and about 40 000 specimens in alcohol from different localities. – Belgium: 1 ♂: Bayne, 23–4–42, marche sur l'eau. *Coprophila ferruginata* ST. det. VANSCHUYTBROECK. – Bulgaria: 1 ♀: Mt. Balkan, SZILÁDY, 11. 7. 1928; 1 ♂: Varsec, 1–10. 8. 929, SZILÁDI. – Mongolia (PAPP (12). – Korean People's Republic*: 1 ♀: Prov. South Pyongan, Chang lyong san, 50 km N from Pyongyan, 13. 8. 1971, leg. HORVATOVICH and PAPP, J. (No. 172). – Australia: 1 ♂: Queensland, Townsville, 16–22. 3. 1965, Exp. Dr. J. BALOGH, Townsville 21; 1 ♀: ibid., Townsville 11. (new to Queensland). – Bolivia*: 169 ♂, 143 ♀: Guayaramerin (Beni), Estancia Esperanza, 29–30. 11. 1966, on lamp light (No. 417), leg. BALOGH, MAHUNKA, ZICSI. – Argentina: 1 ♀: Buenos Aires, Ezeiza, 10. 12. 1961, TOPÁL (No. 771). – Ghana: 1 ♀: Busua, 26. 3. 1969, light trap (No. 329), ENDRŐDY–YOUNGA. – Congo: 1 ♂: Brazzaville, ORSTOM park, 21. 12. 1963, light trap, leg. S. ENDRŐDY–YOUNGA (No. 491); 1 ♂: ibid., 30. 12. (No. 563); 1 ♂: ibid., 27. 12. (No. 534). – Tanzania: 1 ♂: Afr. or. KATONA, 904. X., Kilima-Ndjaro, *Coprophila ferruginata* ♂, det. Dr. O. DUDA; 1 ♀: ibid., Shirati, 909. II., *C. ferruginata* STEH. ♀, det. O. DUDA. – Abyssinia: 1 ♀: Marako, 1912. III., KOVÁCS, *C. ferruginata* ST. det O. DUDA. Cosmopolitan.

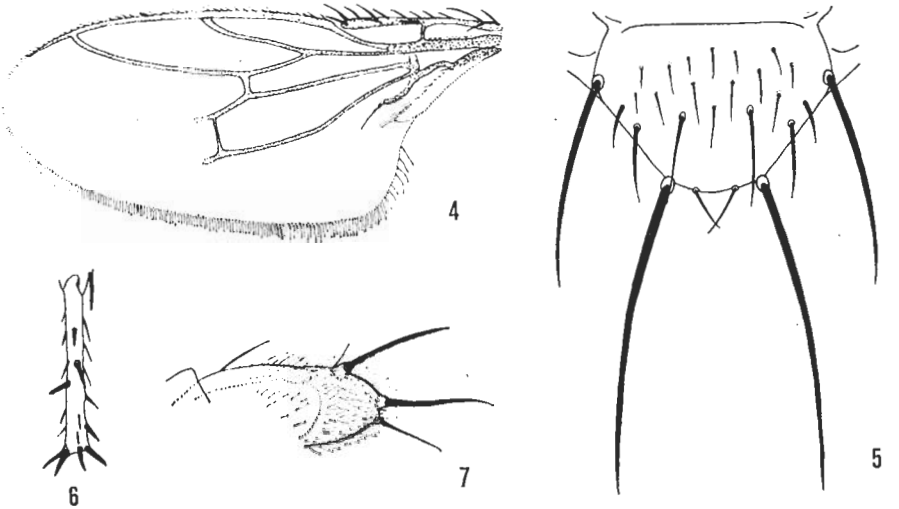


Fig. 4–7. *Coproica ghanensis* sp. n. ♀. *4:* wing; *5:* scutellum; *6:* mid metatarsus in ventral view; *7:* cercus in lateral view

Coproica ghanensis sp. n.

Holotype somewhat faded, reddish yellow, somewhat darker when alive. Head 1.6 times higher than long. Four pairs of small interfrontals. Third antennal joint and arista with very short (shorter than 0.01 mm) pubescence. Eyes rather big, longest diameter about 4 times longer than smallest genal width, thus genal rather narrow in the anterior part but strongly widening in the posteior part. Mesonotum with 1–1 inclinate and reclinate h, 2 np, 1 prst, 2 sa, 1 pa, 1 dc, 1 prsc, 2 sc, 1 short anterior and 1 well-developed posterior st pairs. Acmi sparse, only 4–6 rown between dc lines. Scutellar bristles (Fig. 5) very interesting, as it has rather few (16) discal ones in asymmetrical position, including 1 pair of very long discal bristles. Mid tibial armature: a moderately strong ventral bristle at 7/12, moderately long ones at 1/4, 13/24, a very strong anterodorsal one at 17/24, a weak but distinct posterodorsal one at 5/12, and a very long thick posterodorsal one at 2/3; subapical wreath of bristles. Armature of mid metatarsus: 1 ventral bristle near 1/3 of mt_2, 1 anteroventral one at 1/2 and a somewhat more distally placed posteroventral one; all these bristles are only moderately long (Fig. 6.). Legs normal, ochreous yellow. Wings (Fig. 4) highly interesting. Costa ends before wing apex, r_{2+3} ending at a rather wide angle in c, r_{4+5} strongly upcurving and ending very far from wing apex, $c_x = 0.97$, $t_a - t_p$ only a little longer than t_p. Anal vein rudimentary (I was unable to see more than the one on Fig. 4.) Hind margin of wing with sparse but long ciliae. Wing measurements of holotype female: 0.85×0.37 mm. Knob of halteres comparatively big, ochreous yellow, stalk darker, brownish. Female cercus with two strong bristles (dorsal one comparatively very thick) and a shorter, thick, stiff one (Fig. 7).

Body length of holotype female: 1.10 mm.

Holotype female: Ghana, Nakpanduri, 7. 8. 1967, sifted, singled, cow dung, leg. S. Endrődy – Younga (No. 249).

Coproica ghanensis sp. n. is an easily identifiable species, which shows a series of peculiar characteristics. There is no near relative in the genus *Coproica* ROND. It has a rudimentary anal vein, a weak but distinct bristle at about the middle of the posterodorsal side of mid tibia, a characteristic armature of mid metatarsus, asymmetrically placed discal bristles on scutellum (including a pair of very strong discal bristles). Also the three pairs of short or moderately long, stiff (not wavily bent) bristles on female cerci are highly characteristic.

Coproica hirticula COLLIN, 1956

Hungary: 113 ♂, 36 ♀ pinned specimens, as well as other specimens in alcohol from different localities. It was known only from Europe but has been found recently also in Australia.

Coproica hirtula (RONDANI, 1880)

Hungary: 41 ♂, 41 ♀ pinned and some other specimens in alcohol from different localities. – Germany: 2 ♂, 3 ♀: Eickel, 6. 9. 16. *hirtula* det. O. DUDA. – Italy: 1 ♀: Carlopago, 12. 7., *pseudolugubris* ♀ det. O. DUDA. – Bulgaria: 1 ♂: Varna, SZILÁDY, 2. 7. 1928. – Afghanistan (PAPP). – Korean People's Republic: 1 ♂, 1 ♀: Chang-lyong san, leg. HORVATOVICH and J. PAPP (No. 172); 1 ♂: Pyongyan, city park between river Te-dong and Pyongyan Hotel, 1. 9. 1971, leg. HORVATOVICH and J. PAPP (No. 227). – Vietnam*: 2 ♀: Hanoi, light trap, 4. and 12. 9. 1963, MANNINGER; 1 ♀: Prov. Yen Bai, Minh Xuan, netted on buffalo droppings, 3. 12. 1971, TOPÁL and MATSKÁSI; 1 ♂: ibid., Luc Yen, along Chay river, extracted from material under tree bark, 6. 12. 1971. – China: Formosa, Sauter: 10 ♂, 14 ♀: Takao, different time data from 3. 1. 1907. to 12. 1912; 2 ♀: Tainan, 4. 1912; 1 ♀: Anping, 4. 1912. – India*: 2 ♀: Orissa, Daitari, 1. 12. 1967, neon light, leg. TOPÁL (No. 987); 1 ♀: Matheran, 800 m, 8. 7. 1902, BIRÓ. – Jemen*: 2 ♀: Wadi Zabid, 8. 1970, on light, leg. A. SZALAY – MARZSÓ. – Ethiopia: 3 ♂: Abyssinia, KOVÁCS, Dire-Daua, 19. 11. 1911., *C. hirtula* ♂ det. O. Duda. – Congo: leg. BALOGH et al., 1963 – 64: 1 ♀: Brazzaville, ORSTOM park, light trap, 19. 11. 1963. (No. 214); 1 ♀: ibid., 21. 12. (No. 491); 1 ♂, 1 ♀: ibid., 30. 12. (No. 563). – GHANA*: leg. S. ENDRŐDY – YOUNGA 1965 – 71: 1 ♀: Kumasi, light trap, 5 – 6. 6. 765. (No. 10); 1 ♀: Kwadaso). 25. 2. 1969. light trap (No. 313); 1 ♂: ibid., 3. 3. 1969. (No. 318); 1 ♀: ibid., 10. 3. 1969. (No. 323); 1 ♀: Busua, 26. 3. 1969. light trap (No. 329); 1 ♀: Sese, 17. 6. 1969. air plankton (No. 372); 1 ♀: Kumasi, 25. 6. 1969. air plankton (No. 376); 1 ♀: Kwadaso, light trap. 30. 6. 1969. (No. 379) 2 ♂, 3 ♀: Kwadaso, Berlese sample, dump hill of poultry farm, from under cadavers, 9. 10. 1969. (No. 400); 8 ♂. 12 ♀: Tamale, light trap, 12. 2. 1971. (No. 456); 1 ♂, 2 ♀: Ho, air plankton, 15. 9. 1971 (No. 475). – New Guinea: 1 ♂, 3 ♀: Erima Astrolabe B., BIRÓ, 11. 1896; 1 ♀: Seleo, Berlinhaf. BIRÓ, 96; 1 ♀: Stephansort, Astrolabe Bai, 7. 4. 1900. BÍRÓ. – Bolivia: 9 ♂, 16 ♀: Guayaramerin (Beni), Estancia Esperanza, 29 – 30. 11. 1966, leg. BALOGH, MAHUNKA, ZICSI (No. 417). It became a cosmopolitan species by human activity.

Coproica hirtuloidea (DUDA, 1925)

Bolivia: 2 ♂, 3 ♀: Guayaramerin (Beni), Estancia Esperanza, lamping, 29 – 30. 11. 1966, leg. BALOGH, MAHUNKA, ZICSI (No. 417). It is known only from Peru and Bolivia (DUDA (7), RICHARDS (14)].

Coproica lugubris (HALIDAY, 1836)

Hungary: 110 ♂, 79 ♀ pinned specimens and several dozen specimens in alcohol from different localities. – Bulgaria: 1 ♂, 3 ♀: Varsec, 1 – 10. 8. 1929. leg. SZILÁDY. – Tunisia*: 1 ♀: Tunis, Hoegen, *lugubris* ♂, det. O. DUDA. – Afghanistan (see PAPP (12)]. – Korean People's Republic*: 42 ♂, 31 ♀: Prov. South Pyongan, Chang-lyong san 50 km N of Pyongyan and 15 km E from Sa-gam, 13. 8. 1971, leg. HORVATOVICH and J. PAPP (No. 172). Formerly it was known only from Europe but its occurrence in Tunisia, Afghanistan and Korea shows that it has in all probability a wide Palearctic distribution.

Coproica pseudolugubris (DUDA, 1925)

Limosina (Coprophila) pseudolugubris DUDA, 1924: Verhandl. zool. – bot. Ges. Wien, 73 (1923): 170, 179.

Lectotype female. 1.07 mm (measured also along abdomen curving down). Dark brown species with grey pruinosity, facial plate, anterior part of genae, fore coxae, knees and tarsi with some yellowish hue. Four pairs of rather strong interfrontals. Eyes rather big, longest diameter/smallest genal width = 3.5. Arista only 2.8 times longer than antenna. Mesonotal and scutellar chaetotaxy as in its congeners. 1 minute anterior and 1 small posterior sternopleurals. Mid tibial armature: anterodorsals: one rather strong at 1/4, a smaller one at 8/15, a very strong one at 3/4; posterodorsals: only one very strong at 3/4; small subventral bristle at about middle. Mid metatarsus with 5 (partly unpaired) short bristles ventrally [see PAPP (10): Fig. 15 (M, N)]. Wings light grey, veins light brown. Wing measurements of lectotype ♀: 1.08 x about 0.45 mm (not measurable exactly, as wings are somewhat wrinkled). Costa ends near wing apex, with comparatively short birstles on mg_2 but with rather long ones on mg_2 and $mg_3 \cdot \cdot c_x = 0.81$. $t_a - t_p = 1.2$. Anal vein angularly sinuate. Female cercus with 2 very long wavily bent, 1 medium-sized straight and some shorter hairs.

Lectotype female: Gyón, KERTÉSZ – *"C. pseudolugubris"* ♀ 1920. X. 2. [DUDA's or KERTÉSZ's handwriting], det. Dr. O. DUDA.

Paralectotypes: 4 ♂ on two insect pins (1 + 3): data same as for lectotype; 1 ♀: ibid., 17. 5. 1921.; 30 ♂, 7 ♀ on 19 insect pins: ibid., 22. 5. 1921.; 1 ♀: ibid., 17. 5. 1921. Paralectotypes in Zoologisches Museum, Berlin: 9 ♂: 16 8 20 (on 2 mm (wide orange labels), Königsfeld (on 3 mm wide white labels), *pseudolugubris* ♂ on 4 mm wide white labels) (every label with DUDA's handwriting); 1 ♀: 17 8 20 – *pseudolug.* ♀ (DUDA's handwriting without Königsfeld label and with time specification different from that in description, still, it has to be a member of the type-series). I designated specimens in our Collection to paralectotypes with different time specification as given in the description, because I am sure that DUDA had identified them at the same time together with specimens of 2. 10. 1920. [In his paper there are data of 13. 6. 1921. and 20. 5. 1921. for syntypes of *L. (Rachispoda) modesta* (DUDA, 1924), thus it is obvious that KERTÉSZ sent also the material of May and June 1921 in the same parcel as the specimens from 1920.]

Other specimens in HNHM: Hungary: 7 ♂, 3 ♀: Gyón, KERTÉSZ (without any other data); 38 ♂, 33 ♀ from different localities; 1 ♂, 2 ♀: Gyón, KERTÉSZ, 19. 5. 1921, *hirtula* det. O. DUDA. – Jugoslavia: 1 ♂: Novi, KERTÉSZ, 26. 6. 1899., *pseudolugubris* ♂, det. DUDA. – Bulgaria*: 1 ♂: Rila, Monast., 24. 8. 1929., leg. SZILÁDY. – Mongolia: 39 ♂, 44 ♀ (PAPP, 11). – Afghanistan (PAPP, 12). Formerly it was reported from Europe, from Belgian Congo (Zaire) (VANSCHUYTBROECK, 15) and from Ethiopia (DUDA, 7, 8). As later data proved to be erroneusly identified, I think also the other extra-Palearctic data need revision.

Coproica serra (RICHARDS, 1938)

Ethiopia: 3 ♀: Abyssinia, KOVÁCS – Dire-Daua, 19. 11. 1911., *Coprophila pseudolugubris* ♀ (DUDA's handwriting), det. O. DUDA. The specimens well agree with the description of *serra* RICH. (only 1 minute sternopleural bristle, only small bristles or hairs on costa, $c_x \sim 0.9$, no posterodorsals

at 1/4 and 1/2 of mid tibia, head black, body length 1.6–1.8 mm, vein r_{4+5} ending as far from wing apex as vein m, angle of r_{2+3} with c varies with specimens). Mid metatarsus with a strong basal ventral bristle and with a smaller but rather strong ventral one about middle [not a pair of bristles ther as described for *ruwenzoriensis* (WANSCH.), cf. RICHARDS (14): 206].

Coproica vagans (HALIDAY, 1833)

Hungary: 163 ♂, 148 ♀ pinned specimens and over 20 000 specimens in alcohol from different localities. – Jugoslavia: 1 ♀: Novi, KERTÉSZ, 11. 7. 1900. – Romania: 1 ♀: Csik–Szépvíz, FODOR, Vörösláz, 1009 m, 6. 7. 1917., „*Copr. albipennis* Rond." det. Dr. O. DUDA. – Italy: 1 ♀: Carlopago, 12. 7. – Tunisia: 1 ♂: Gabes, BIRÓ, 18. 3. 1903., *vagans* ♂, det. O. DUDA; 3, ♂, 10 ♀: Sfax BIRÓ, 7. 3. 1903, *vagans* det. O. DUDA, on one of them: *Limosina albipennis* ROND. det. BECKER; 1 ♀: Gafsa, BIRÓ, 22. 3. 1903, *vagans* v. *flava* det. O. DUDA. – Afghanistan (PAPP, 12). – Mongolia (PAPP, 11). – Chile: 1 ♂: Azapa (Prov. Tarapaca) 25 km E from Arica, on riverside of Rio Lauca, 18. 11. 1965 (No. 128/4) (for detailed data see ANDRÁSSY, BALOGH et al.). Cosmopolitan on account of human activities. Its variety *Coproica vagans* var. *flava* (DUDA, 1918) has no taxonomic value. It occurs only in subtropical and infrequently, in tropical territories, where the melanin-synthesis in the cuticle of the imagos is interrupted because of the climatic factors.

Other known species of *Coproica* ROND. not found in the collection of the HNHM: *C. cacti* (RICHARDS, 1960), *C. mitchelli* (MALLOCH, 1913), *C. setulosa* (DUDA, 1929) and *C. urbana* (RICHARDS, 1960). Doubtful species: *Coproica disticha* (BECKER, 1919): described as *Limosina*, genus uncertain; *Coproica ruwenzoriensis* (VANSCHUYTBROECK, 1950): RICHARDS (14) thought it a possible synonym of the species *serra* RICH.

I am greatly indebted to the research workers of the Department of Systematic Zoology and Ecology of the Eötvös Loránd University and of the Hungarian Natural History Museum, who collected the above materials. I am very grateful to Dr. H. SCHUMANN for helping with my work in the Museum für Naturkunde, Zoologisches Museum, Berlin.

REFERENCES

1. ANDRÁSSY, I., BALOGH, J., LOKSA, I., MAHUNKA, S. & ZICSI, A. (1967): *The scientific results of the Hungarian soil zoological expedition to Chile, Argentina and Brasil, I. Report on the collectings.* – Folia Ent. Hung., 20: 247–296.

2. BALOGH, J., ENDRŐDY–YOUNGA, S. & ZICSI, A. (1965): *The scientific results of the Hungarian soil zoological expedition to the Brazzaville-Congo. A report on the collectings.* – Folia Ent. Hung., 18: 213–280.

3. BALOGH, J., MAHUNKA, S. & ZICSI, A. (1969): *The scientific results of the Hungarian soil zoological expeditions to South America. 14. A report on the collectings of the second expedition.* – Folia Ent. Hung., 22: 453–474.

4. COLLIN, J. E. (1956): *Some new Borboridae (Diptera).* – J. Soc. Brit. Ent., 5/5: 172–178.

5. DUDA, O. (1918): *Revision der europäischen Arten der Gattung Limosina Macquart (Dipteren).* Abh. zool.-bot. Ges. Wien 10: 1–240.

6. DUDA, O. (1924): *Berichtigungen zur Revision der europäischen Arten der Gattung Limosina Macq. (Dipteren) nebst Beschreibung von sechs neuen Arten.* – Verhandl. zool.-bot. Ges. Wien, 73 (1923): 163–180.

7. DUDA, O. (1925): *Die aussereuropäischen Arten der Gattung Leptocera Olivier = Limosina Macquart (Dipteren) mit Berücksichtigung der europäischen Arten.* – Arch. f. Naturg., 90A(11)1924): 5–215.

8. DUDA, O. (1938): *57. Sphaeroceridae (Cypselidae).* – In LINDNER: Die Fliegen der palaearktischen Region, 6/1: 1–182.

9. Endrődy – Younga, S. (1970): *Entomological explorations in Ghana by Dr. Endrődy – Younga. 1. A diary of entomological collection in Ghana 1965 – 1969.* – Folia Ent. Hung., 23: 5 – 91.

10. Papp, L. (1973): *Trágyalegyek – Harmatlegyek (Sphaeroceridae – Drosophilidae).* – In: Fauna Hungariae, XV/7, Budapest, pp. 146.

11. Papp, L. (1973): *Sphaeroceridae (Diptera) from Mongolia.* – Acta Zool. Hung., 19: 369 – 425.

12. Papp, L. (1978): *New species and records of Sphaeroceridae (Diptera) from Afghanistan.* – Acta Zool. Hung., 24: in print.

13. Richards, O. W. (1938): *Diptera Sphaeroceridae (Borboridae, Cypselidae).* – In Jeannel, R.: Mission scientifique de l'Omo, 4: 381 – 405.

14. Richards, O. W. (1960): *On two N. American species of Leptocera Oliv., subgenus Coproica Rdi., with a review of the subgenus (Dipt., Sphaeroceridae).* – Ann. and Mag. Nat. Hist., Ser. 13, 2/16: 199 – 208.

15. Vanschuytbroeck, P. (1950): *Diptères Sphaeroceridae du Musée du Congo Belge.* – Ann. Mus. Congo Belge (8) Zool., 5: 1 – 46.

Opusc. Zool. Budapest, XVI, 1–2, 1979

The Crustacea of the Hungarian Area of Lake Fertő

By

J. E. Ponyi and I. Dévai*

Abstract. The authors studied the Crustacea in samples taken from 43 sites of collection in the Hungarian area of Lake Fertő in the years 1960–61. In the course of the examinations they demonstrated 22 Cladocera, 8 Ostracoda, 14 Copepoda and 1 Isopoda species. Comparing the results with earlier literary data, they found that a considerable exchange of species took place in the Cladocera fauna. A species of Ostracoda, *Potamocypris unicaudata* Schäfer proved to be new for the Hungarian fauna. In the summer season the open-water Crustacea association is characterized by the species *Diaphanosoma brachyurum – Bosmina longirostris – Acanthocyclops vernalis – Arctodiaptomus spinosus*. The open-water pondweed field can be characterized by the *Alona rectangula – Acanthocyclops vernalis – Diaphanosoma brachyurum – Bosmina longirostris* species.

In 1960 we started, similarly to Lake Balaton (Tóth, 1960, 1960 *a:* Ponyi, 1962, 1965; Iharos, 1964), a complex examination of the Hungarian area of Lake Fertő. While the evaluation of the botanical and chemical works reached completion and was published the year after (Tóth, Szabó, 1961; Szabó, 1962), the elaboration of the collected zoological material could not take place on account of a variety of obstacles.

In the meantime the Fertő-Region Committee of the Hungarian Academy of Sciences was formed, and its efficient activity had for result, that from 1970 on the volumes of the "Data collection in preparation for the monograph of the Fertő Region" have been appearing one after the other. On page 453 of Vol. 3 the following statement about Crustacea may be read: "... one can refer so-to-say only to Daday's works published at about the turn of the centuries" (Andrikovics & Berczik, 1975a). Among others also this inspired us to elaborate th-Crustacea of the samples after a long while. Still, our true purpose was to obtain a comparative picture about the composition as to species and in per cent of the Crustacea of Fertő and Balaton – the two most extensive lakes of Hungary. We also wanted to know whether we shall find in the reed fields of Lake Fertő the peculiar "zones" (Balogh, 1953) characteristic of the well-developed reeds of Lake Balaton.

* *Dr. Jenő E. Ponyi.* MTA Biológiai Kutató Intézete (Biological Research Institution of the Hungarian Academy of Sciences). 8237 Tihany. – *Dr. István Dévai.* Hajdu-Bihar Megyei Víz- és Csatornázási Művek (Hajdu-Bihar County Water- and Canal Works), 4010 Debrecen, Hét Vezér

Characterization of the sites of collection

We have indicated the sites of collection in Fig. 1., marked with numbers 1 to 43. For each site of collection we describe the method of collecting, as well as the circumstances which could be of importance in evaluating the results. The adopted methods of collection were suited only for determining the quality and the percentual distribution of the species. The samples were taken between July 12th – 15th, August 16th – 18th, September 14th – 15th, and on December 20th, 1960, April 24th and 25th, 1961.

The results of the chemical examinations are to be found in the work of Tóth and Szabó (1961).

Collection on 12th – 15th July, 1960

No. 1. 100 m towards the open water from the verge of the reeds we filtered 10 l of scooped water through a No. 18 plankton net. Depth of water: 80 cm, Secchi's transparency: 27.0 cm, water temperature: 22.2 °C; pH = 8.6.

No. 2. A small pondweed islet (mainly *Myriophyllum spicatum* and some *Potamogeton pectinatus)* in the vicinity of the preceding (No. 1) site; we took a scooped sample from among the single weeds and filtered it in the way as described under No. 1.

No. 3. In the place indicated in Fig. 1 we towed a No. 6 plankton net from a boat through a distance of about 300 m parallelly with the verge of the reed field, ot about 150 m from it. This sample essentially combines the Crustacea species living in the so-called "open water" and "open-water pondweeds". On account of the shallowness of the Lake, the way of the collection led through larger or smaller pondweed clumps not extending over the surface of the water.

No. 4/a. Sample collected among the single *Typha* plants by towing a No. 18 net in the outer part of the reed-type Scirpeto-Phragmitetum typhosum.

No. 4/b. Collection of *Typha* coating. The method is identical with the one applied by Ponyi (1962) for examining the coating of read.

No. 5. The reed-type Scirpeto-Phragmitetum utricullariosum is the most characteristic one of Lake Fertő. Depth of water: 5 – 10 cm. Marshy, slack water. The frequent occurrence of snails belonging to the genera *Planorbis* and *Limnaea* was remarkable.

No. 6/a. Coating of *Myriophyllum spicatum*. The description of the collecting method can be found in Ponyi's (1956) paper. The site of collection is the so-called "Herrenlacken", a "lake" encircled by reed fields. Site of collection: 30 m from the fringe of the reed field.

No. 6/b. A 10 l sample, scooped from among the stalks of *Myriophyllum spicatum* was filtered through a plankton net (No. 18). Depth of water: 69 cm, Secchi's transparency: 15.0 cm, water temperature: 18.4 °C; pH = 8.7.

No. 7. The sample was taken from the middle of the Herrenlacken, about 200 m from the reed fringe, by towing a No. 18 plankton net from a boat through a distance of about 200 m. The "lake" (the Herrenlacken) was fairly weedy even in the middle. Depth of water: 80 cm, Secchi's transparency: 18.4 cm, water temperature: 18.6 °C; pH = 8.7.

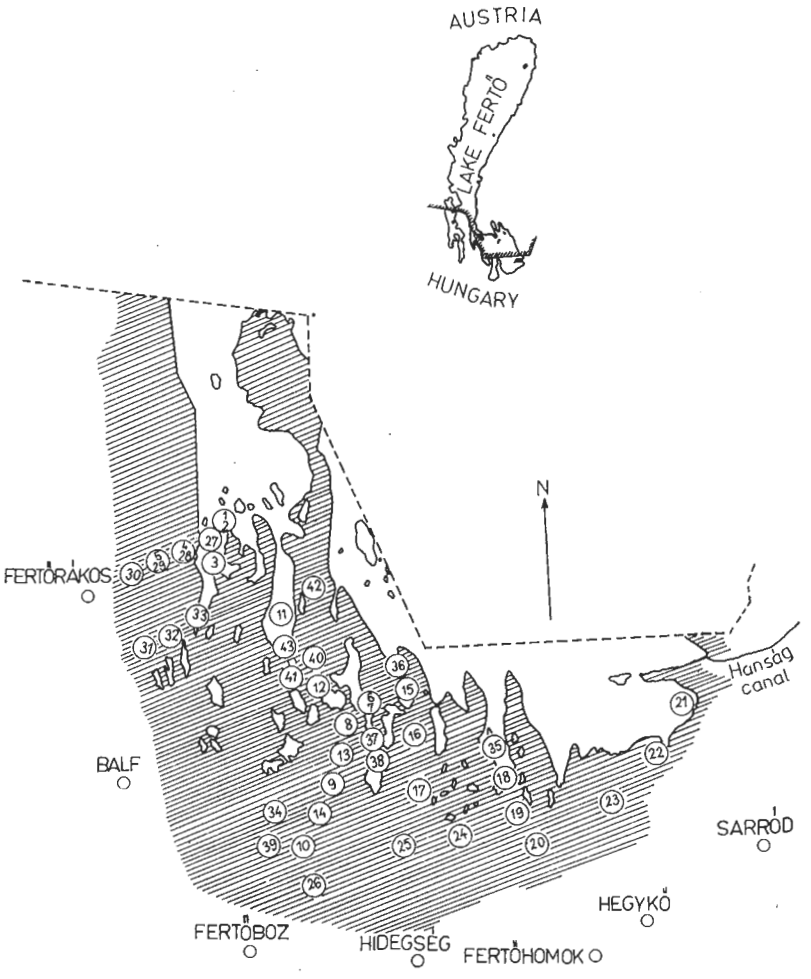


Fig. 1. Collecting sites in the Hungarian area of Lake Fertő. (Detailed explanations see in the text)

No. 8. Scirpeto-Phragmitetum utricullariosum reed-type. Besides *Utricularia vulgaris* a great quantity of detritus is to be found. Samples were collected with nets (No. 16 and 18). Water temperature: 18.4 °C; pH = 8.0.

No. 9/a. The reed-type Scirpeto-Phragmitetum utricullariosum has a peculier aspect, characterized by the mass-vegetation of *Drepanocladus aduncus* var. *kneifii*. As a rule it appears when the recession of the water begins. The samplle was taken in a way that the water in the moss was filtered through a plankton net (No. 18).

No. 9/b. *Drepanocladus* moss. It was "washed out" with care in a pail of filtered water, and the water was filtered through a No. 18 net.

No. 9/c. Collection from among *Drepanocladus* by means of a No. 6 net.

No. 10/a. Sample collected with a fine (No. 18) and a coarse (No. 6) net at the reed-free border of a plot of reeds. We observed Hydracarina as well as *Limnaea* snails in great numbers.

No. 10/b. Collection with nets (No. 6 and 18) in the reedy area of the preceding (No. 10/a) reed plot.

No. 11. Open water free of pondweed, collection with plankton net No. 18. Depth of water: 83 cm, Secchi's transparency: 17.5 cm, water temperature: 21.0 °C; pH = 8.5.

No. 12. Canal. Collection with fine and coarse nets (No. 18, No. 6), material poured together. Water temperature: 19.00 °C; pH = 8.3.

No. 13. Canal. We collected between reed and sedge with a coarse net (No. 6). Water temperature: 19.0 °C; pH = 7.9.

No. 14/a. Water sample sccoped from among *Drepanocladus* was filtered through a No. 18 net. There is no continuous water layer — larger or smaller pools can be obcerved.

Collection on 16th—18th August, 1960

No. 15. Open water free of vegetation. 20 l of scooped water filtered through a No. 18 net. Depth of water: 30 cm.

No. 16. Collected among reeds with a No. 6 net. No continuous water layer, the collected sample contains a great mass of plant fragments.

No. 17. Sample taken with a net (No. 6) among reeds.

No. 18. Open water. A 30 l scooped sample filtered through a No. 18 net.

No. 19. Canal. Sample collected with a dip-net (No. 6), in the surrounding reeds there is no water.

No. 20. Collection among reeds with a net. No continuous water layer over the ground.

No. 21. Open water, a 30 l scooped sample filtered through a No. 18 net.

No. 22. Canal. 30 l water filtered through a net No. 18. Depth of water: 70 cm. There is no water in the surrounding reed plots.

No. 23. Canal, sample collected from the shore with a dip net (No. 18). Depth of the water: 62 cm.

No. 24. Pool — the so-called "Guszti-tó" — (a pond in the Lake). Only 2—3 cm deep puddles are to be found. The water is transparent, we scooped it with care and filtered it through a (No. 18) plankton net.

No. 25. Canal. 30 l of scooped water filtered through a plankton net (No. 18). Depth of water: 80 cm.

No. 26. Slack water at the origin of one of the canals, intensely overgrown with pondweed. Collection with a No. 16 plankton net.

Collection on 14th—15th September, 1960

No. 27. Open water, a 10 l water sample scooped at about 150 m from the edge of the reeds and filtered through a No. 18 net.

No. 28. Collected from the border of a canal with a No. 6 net. Depth of the water: 90 cm.

No. 29. Pools. Opening in the weed field, produced by a tractor. Shallow, not continuous water surface. Collected with a No. 18 net.

No. 30. Dense reeds, narrow track overgrown with *Chara*. Sample was taken with a No. 16 net.

No. 31. Narrow, free water surface in reeds. Sampling with a net (No. 18).

No. 32. Dense reed field. Long-shaped depression produced by tractor, with 4 – 5 cm water. Collected with net No. 18.

No. 33. Open water. A 50 l water sample filtered through a No. 18 plankton net.

Collection on 20th December, 1961

No. 34/a. Reed plot. 25 l water sample, scooped from reed-free area, filtered through net No. 18.

No. 34/b. Reed plot. Collection from among the single reeds with nets (No. 16 and 18).

Collection on 24th – 25th April, 1960

No. 35. Open water. Samples scooped and taken with net (No. 18) combined.

No. 36. Open water; 25 l scooped water filtered through a No. 18 plankton net.

No. 37. Open water; 25 l scooped water sample taken from the "Herrenlacken" at about 30 m from the edge of the reeds and filtered through a No. 18 planktoton net.

No. 38. Open water; 25 l water sample from the middle of the "Herrenlacken" filtered through a No. 18 plankton net.

No. 39. Sample taken from plant-free "open-water" in corner of a reed plot, with plankton nets No. 18 and 6.

No. 40. Canal; 25 l water sample filtered through a No. 18 net.

No. 41. Sample taken with plankton nets (No. 6 and 18) from reed fields near canal No. 40.

No. 42. Sample taken with nets (plankton nets No. 6 and 18) from well-developed reeds.

No. 43. Open water; a 25 l water sample filtered through net No. 18.

Enumeration of the found species and their comparison with the earlier data

In the course of our examinations we found 22 Cladocera, 8 Ostracoda, 14 Copepoda and 1 Isopoda species. Also taking into consideration the data in the literature (cf. Tables 1 – 3), the number of the species recorded in Lake Fertő is much higher: Cladocera 43, Ostracoda 16, Copepoda 22. In the present study the authors do not deal with the Malacostraca species in grater detail.

As it appears from the comparison of the available literary data (Table 1) the Cladocera faunule of Lake Fertő has greatly changed. DADAY (1890, 1891, 1897, 1900) mentioned 25 species from the Lake, out of which 13 species *(Sida crystallina, Ceriodaphnia rotunda, Moina brachiata, Eurycercus lamellatus, Acro-*

Table 1. Cladocera species observed in Lake Fert up to the present

Species	t. s.	Daday	Pesta	Zakovsek	Ponyi and Dévai
		1890–1892	1950–1952	1950–1952	1960–1961
	i. d. p.	1890 1891 1897 1900	1954	1961	1976
1. *Sida crystallina* (O. F. Müller)		+	–	–	–
2. *Diaphanosoma brachyurum* (Liév)		+	+	+	+
3. *Daphnia (Ctenodaphnia) magna* Straus		–	+	–	–
4. *Daphnia (Daphnia) pulex* Leydig		–	+	+	–
5. *Daphnia (D.) curvirostris* Eylm. emend. Johnson		–	–	–	+
6. *Daphnia (Daphnia) longispina* O. F. Müller		+	+	+	–
7. *Daphnia (Daphnia) hyalina* Leydig		–	–	–	+
8. *Ceriodaphnia reticulata* (Jurine)		–	+	+	+
9. *Ceriodaphnia quadrangula* (O. F. Müller)		+	+	+	+
10. *Ceriodaphnia laticaudata* P. E. Müller		–	+	+	+
11. *Ceriodaphnia rotunda* G. O. Sars		+	–	–	–
12. *Simocephalus vetulus* (O. F. Müller)		+	+	+	+
13. *Simocephalus expinosus* (Koch)		–	+	–	+
14. *Simocephalus expinosus* (Koch) var. *congener* Schoedler		–	–	–	+
15. *Scapholeberis mucronata* (O. F. Müller)		+	–	+	–
16. *Scapholeberis kingi* G. O. Sars		–	–	–	+
17. *Scapholeberis aurita* (Fischer)		–	–	–	+
18. *Moina rectirostis* (Leydig)		–	+	–	–
19. *Moina micrura* Kurz		–	–	–	+
20. *Moina brachiata* (Jurine)		+	–	–	–
21. *Bosmina (Bosmina) longirostris* (O. F. Müller)		+	+	–	+
22. *Bosmina (Bosmina) longirostris* (O. F. M.) var. *cornuta* Jurine		+	–	–	–
23. *Ilyocryptus sordidus* (Liévin)		–	–	+	+
24. *Macrothrix laticornis* (Jurine)		+	–	–	+
25. *Macrothrix hirsuticornis* Norman et Brady		–	+	+	–
26. *Eurycercus lamellatus* (O. F. Müller)		+	–	–	–
27. *Acroperus elongatus* (G. O. Sars)		+	–	–	–
28. *Acroperus harpae* (Baird)		+	–	–	–
29. *Tretocephala ambigua* (Lilljeborg)		–	+	+	–
30. *Oxyurella tenuicaudis* (G. O. Sars)		+	+	–	+
31. *Alona guttata* G. O. Sars		+	–	–	–
32. *Alona rectangula* G. O. Sars		+	+	+	+
33. *Alona quadrangularis* (O. F. Müller)		+	–	–	–
34. *Leydigia acanthercoides* (Fischer)		–	–	–	+
35. *Graptoleberis testudinaria* (Fischer)		+	–	–	–
36. *Alonella excisa* (Fischer)		+	–	+	+
37. *Pleuroxus laevis* G. O. Sars		+	–	–	–
38. *Pleuroxus trigonelleus* (O. F. Müller)		+	–	–	–
39. *Pleuroxus uncinatus* Baird		+	–	–	–
40. *Pleuroxus aduncus* (Jurine)		–	+	+	+
41. *Dunhevedia crassa* King		+	–	–	–
42. *Chydorus sphaericus* (O. F. Müller)		+	+	+	+
43. *Polyphemus pediculus* (Linnaeus)		–	+	+	+

Key to the abbreviations: t. s. = time of sampling; i. d. p. = imprint date of the publication

Table 2. Ostracoda species demonstrated up to now from Lake Fertő

Species		Daday	Imhof	Ponyi and Dévai
	t. s.	1890–1892	1966	1960–1961
	i. d. p.	1897 1900	1966	1976
1. *Ilyocypris gibba* (Ramdohr)		+	(+)	–
2. *Ilyocypris bradyi* G. O. Sars		–		+
3. *Notodromas monacha* (O. F. Müller)		+		+
4. *Cypris pubera* O. F. Müller		+		+
5. *Heterocypris incongruens* (Ramdohr)		+		–
6. *Heterocypris salina* Brady		–		+
7. *Cypridopsis newtoni* Brady et Robertson		+		–
8. *Cypridopsis vidua* (O. F. Müller)		+		–
9. *Potamocypris unicaudata* Schäfer		–		+
10. *Cyclocypris ovum* (Jurine)		–	(+)	+
11. *Cyclocypris laevis* (O. F. Müller)		+		+
12. *Cypria ophthalmica* (Jurine)		+		+
13. *Candona candida* (O. F. Müller)		+		–
14. *Candona parallela* G. W. Müller		–	+	–
15. *Candona fabaeformis* Fischer		+	+	–
16. *Limnocythere sancti-patricii* Brady et Robertson		+		–

Key to the abbreviations: t. s. = time of sampling; i. d. p. = imprint date of the publication; (+) = only the genus was indicated by the author

perus elongatus, A. harpae, Alona guttata, Alona quadrangularis, Graptoleberis testudinaria, Pleuroxus laevis, P. trigonellus, P. uncinatus, Dunhevedia crassa) could not be demonstrated since. In the fifties, Pesta (1954) found 18 Cladocera species, out of which only 8 agreed with those also included in Daday's list of the fauna. Zakovsek (1961) mentions 16 species in his study. Out of them 1 species *(Iliocryptus sordidus)* is not included either in Daday's or in Pesta's list. The exchange of the Cladocera faunule is proved by the fact that 10 years upon the thorough examinations of Pesta and Zakovsek we found 5 among the 22 species demonstrated by us, of which the presence in Lake Fertő was unknown before. These are as follows: *Sinocephalus expinosus* var. *congener* (in the opinion of certain authors, e. g. Srámek – Husek et al., 1962, a separate species), *Scapholeberis kingi, Scapholeberis aurita, Moina micrura, Leydigia acanthocercoides.*

5 species, i. e. 12% of the Cladocera could be continually demonstrated: *Diaphanosoma brachyurum, Daphnia longispina, Ceriodaphnia quadrangula, Alona rectangula, Chydorus sphaericus.* In connection with *Daphnia longispina*) we note that in the earlier literature (e. g. Wagler, 1937; Manuilova, 1964.) "*hyalina*" was ranked with *longispina.*

About the quantitative composition and changes of the Ostracoda faunule of Lake Fertő little is known, (Table 2), as no fauna examination of greater detail and thoroughness was done since Daday (1897, 1900). Imhof (1966) mentions only two species. Neither do we find detalis about the Ostracoda of the Lake in

Table 4. Comparison of the numbers of species of the Cladocera, Copepoda and Ostracoda of Lake Fertő and of „Seewinkel""

Suborder and subclass	Lake Fertő according to tables 1 – 3	Seewinkel (LÖFFLER, 1957)	Number of common species
Cladocera	42	16	14
Copepoda	22	14	9
Ostracoda	15	5	2

PESTA and also ourselves can report 15 and 14 species, respectively. A counter argument: the rising number of species finds its explanation not in a change in the environment but in the increased intensity of research. Still, if this were so also the total number of Cladocera should rise; however, the data show the opposite (DADAY demonstrated 25, PESTA and the authors of the present paper 12 and 22 species, respectively; cf. the data of Table 1). The technical shortcomings of the collection are eliminated, as the Copepoda and Cladocera are being caught together.

Recently a significant change ensued also in the faunule of the Copepoda although, as compared with the exchange within the given number of species of the Cladocera, it was of smaller measure. Three of the species mentioned by DADAY *(Macrocyclops fuscus, Paracyclops fimbriatus, Diacyclops nanus)* have not been recorded by any researcher since; we only found two species *(Nitocra hibernica, Thermocyclops dybowskii)* mentioned before (Table 3). In the years of collection between 1890 and 1961 only five species *(Arctodiaptomus spinosus, Eucyclops serrulatus, Cyclops strenuus, Acanthocyclops viridis, Mesocyclops leuckarti)*, consequently 23% of all demonstrated species were identical.

A comparison of the numbers of the Cladocera, Copepoda and Ostracoda species demonstrated from the minor waters of the Seewinkel and of Lake Fertő shows (Table 4) that the majority of the species of the Seewinkel are also to be found in the water of Lake Fertő; 87% in the case of Cladocera species, 64% in that of Copepoda species and 40% in that of the Ostracoda.

A general characterization of the habitats of Lake Fertő

The total area of the Lake is 322 km², of this 82 km² fall to Hungarian territory. Its greater part is covered with reeds, considered "cultivated reed" or "reed-fields put to agriculture" (TÓTH, SZABÓ, 1961). This means that, within the extensive reedy part a radial and transversal network of canals for boats was developed. The canals enclose so-called "reed-plots", from where the reed is cut down each year. Of course, this human interference can be perceived in the life of the reeds. The cleaning of the system of canals involves a continuous disturbance of the edges of the latter. Part of the extensive and uniform reed-fields are destroyed by the heavy tractors and great quantities of *Chara* may develop in their place.

Table 5. The chemical conditions of the open-water and reedy areas of Lake Fertő (Tóth, Szabó, 1961, average data of Tables 1 and 2)

	Open water	Water cowered with reeds
pH	8.8	8.0
O_2 mg/lit.	6.3	2.8
pH	8.8	8.0
pH	8.8	8.0
O_2 mg/lit.	6.3	2.8
El. conductivity $10f \times 18°C$	2058.1	2918.9
dry residue m /lit.	1707.9	1868.1
Ca^{++} mg/lit.	23.9	37.4
Mg^{++} mg/lit.	121.6	128.6
Na^{+} mg/lit.	412.6	413.5
K^{+} mg/lit.	38.3	29.6
CO_2 mg/lit.	0	2.3
CO_3^{-} mg/lit.	62.7	0
HCO^{-} mg/lit.	655.5	954.3
SO^{-} mg/lit.	446.3	451.4
Cl^{-} mg/lit.	227.4	245.7
alkalinity	13.8	15.8
C°	20.2	19.6
Ions total	1988.3	2260.5

The network of canals also affects the submersion of the reed-plots to a high degree. Owing to the varying height of the embankments the phenomenon is frequent that on one side the lower part of the reeds is still covered with water, while on the other it is not.

Table 6. Percentage composition of the

Species	m+h No. 35. (IV. 24.)	m No. 37. (IV. 25.)	m No. 36. (IV. 25.)	m No. 38. (IV. 25.)	m No. 43. (IV. 25.)
1. *Diaphanosoma brachyurum*	0.1	0.6	14.1	1.2	5.5
2. *Bosmina longirostris*	0.1	94.9	1.1	23.9	4.2
3. *Arctodiaptomus spinosus*	98.3	1.2	81.5	60.1	88.0
4. *Acanthocyclops vernalis*	0.3	0.7	–	–	–
5. *Chydorus sphaericus*	0.7	1.1	3.3	1.6	2.3
6. *Alona rectangula*	–	–	–	–	–
7. *Ceriodaphnia quadrangula*	–	–	–	–	–
8. *Eucyclops serrulatus*	0.5	–	–	2.8	–
9. *Moina micrura*	–	–	–	–	–
10. *Cyclops strenuus*	–	1.5	–	9.9	–
11. *Thermocyclops crassus*	–	–	–	–	–
12. *Mesocyclops leuckarti*	–	–	–	–	–
13. *Ceriodaphnia reticulata*	–	–	–	0.5	–
14. *Scapholeberis kingi*	–	–	–	–	–
15. *Oxyurella tenuicaudis*	–	–	–	–	–

Note: m = scooped sample; h = sample taken with net

According to Tóth and Szabó (1961), the reed-field can be divided into three distinct zones. *(1)* The thriving reed-stand in contact with the open water. of which the width depends on the effect of the open water. *(2)* The middle zone, more extensive than the preceding one, where the quality of the reed is somewhat inferior. *(3)* The stand interspersed with sedge and tussocks, situated behind the former is covered with water only in spring and late in autumn. As opposed to the conditions prevailing in Lake Balaton (Tóth, 1960), in the shallow and fluctuating water of the Fertő reed-fields no definite chemical zones can be formed. Thus no reed-types between the open water and the shore, succeeding one another in zones and well separable from each other could arise either.

According to Berczik and Andrikovics (1975) the main types of habitats in Lake Fertő are as follows: *(1)* open water *(2)* sediment and *(3)* areas overgrown with stalked plants, to be divided into weed-fields and reeds. In the course of our examinations – apart from the open-water sediments free from vegetation – we studied the Crustacea of all other habitats.

As to hydrochemistry, the habitats can be ranked with two groups, those of the open-water ones and those covered with reeds. Tóth and Szahó (1961) published chemical data of 7 open-water areas and 8 ones covered with reeds. From the comparison of the average values of these appears (Table 3), that in pH, O_2, conductivity, Ca^{++}, CO_2 and alkalinity there is a remarkable difference between the two groups of habitats. However, apart from CO_2 and CO_3^{--}, the difference is not significant. This is caused by the considerable movement of the water between the two "biotopes". Upon the effect of the north wind the open water of the Lake streams into the reeds and longitudinal canals – again, when the wind blows from the south, the eater streams back towards the open surface of the Lake.

Crustacea planktons of the „open water"

m No. 1. (VII. 12.)	h No. 11. (VII. 15.)	m No. 15. (VIII. 16.)	m No. 18. (VIII. 17.)	m No. 21. (VIII. 18.)	m No. 27. (IX. 14.)	m No. 33. (IX. 15.)
30.2	49.6	36.1	49.4	50.2	22.3	0.6
8.9	2.2	58.3	0.3	–	71.7	98.4
4.7	38.6	–	28.0	26.1	–	–
56.2	5.8	–	20.0	20.9	–	–
–	0.1	2.8	0.3	–	0.4	–
–	0.1	2.8	1.7	0.9	–	–
–	–	–	–	1.9	–	0.6
–	–	–	–	–	–	–
–	–	–	–	–	0.8	0.4
–	–	–	–	–	–	–
–	–	–	–	–	4.4	–
–	3.6	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	0.4	–
–	–	–	0.3	–	–	–

The Crustacea-plankton association of the open water

By the term "open water" we mean the wider water surfaces free of reeds. They can be divided into the following "subtypes" *(a)* extensive open water surface exposed to wind action (e. g. collecting site No. 21); *(b)* water surface more or less surrounded by reeds, still, in direct connection with open water proper (e. g. sites of collection No. 11 and 35); *(c)* water surface completely surrounded by reeds (e. g. the "Herrenlacken" or sites No. 37 and 38); *(d)* the canals free of reeds, which are similarly directly connected with open water proper (e. g. collecting sites No. 12 and 22).

In the open-water marked *(a)*, *(b)* and *(c)* we demonstrated 15 species of Crustacea (Table 6). In quantitative respect, however, only a few species are of importance. In the period of warm weather (July–September) the association *Diaphanosoma brachyurum – Bosmina longirostris – Acanthocyclops vernalis – Arctodiaptomus spinosus* is characteristic. If one also takes consideration the spring examination period (April), then, considering the whole period, the association *Diaphanosoma – Bosmina – Arctodiaptomus – Chydorus* is dominant. Both Crustacea associations differ somewhat from the conditions described regarding the open water of the Austrian part of the Lake (LÖFFLER, 1974). There, namely, the open-water Crustacea plankton can be characterized by the *Diaphanosoma-Arctodiaptomus* association in summer, while in the Hungarian part *Acanthocyclops vernalis* and *Bosmina longirostris* modify these propositions.

In the plankton of the canals we could demonstrate 20 species of Crustacea (Table 7), out of which 11 turned up to on the occasion of only one collection. Relying upon frequency of occurrence, the Crustacea plankton of the canals can be characterized by the association *Arctodiaptomus-Bosmina-Chydorus(-Acanthocyclops vernalis)*, which is identical with the one of the open water. This is a further proof of the connection of the canals with the open water proper.

In the open water we examined the plant islets of *Myriophyllum spicatum* and *Typha angustifolia*. The 16 species demonstrated there agree – excepting 2–3 – with those found in the open water, however, the proportions of coccurrence are different (Table 8). This type of habitat can be characterized by the following Crustacea association: *Alona rectangula – Acanthocyclops vernalis-Diaphanosoma brachyurum – Bosmina longirostris.*

We could examine the aquatic plants of the canals only on two occasions (Table 9). It seems that *Simocephalus vetulus* will be the characteristic species of Crustacea of these habitats.

The composition of Crustacea of the open-water plankton of Lakes Fertő and Balaton collected at an identical period indicates (Table 10) that in both shallow lakes *Diaphanosoma* has a most important role, since in the warm period it forms a considerable per cent of the Crustacea associations (Fertő: 11–45%; Balaton: 17–33%). A further analogy: in both lakes 70–90% of the Crustacea association of the plankton is formed by three species species of Crustacea. Of them one species is common in the two lakes, the other one is represented by a *Diaptomus* in each of them *(Eu-* and *Arctodiaptomus*, respectively), the third is *Acanthocyclops vernalis* and *Bosmina longirostris*, respectively, which is to be found in the somewhat eutrophic areas of Lake Balaton, as well. Although in chemical respect (e. g. Na^+-, or total salt content) there are considerable diffe-

Table 7. The Crustacea plankton of the canal water

Species	No. 12. h VII. 15.	No. 19. h VIII. 17.	No. 22. m VIII. 18.	No. 23. h VIII. 18.	No. 25. m VIII. 18.	No. 28. h IX. 14.	No. 40. m IV. 25.
1. *Diaphanosoma brachyurum*	4.5	40,4	63.6	51.2	65.6	–	8.8
2. *Arctodiaptomus spinosus*	49.0	21.1	25.0	6.1	–	18.0	90.7
3. *Bosmina longirostris*	–	–	2.3	–	34.4	24.8	0.3
4. *Chydorus sphaericus*	2.9	–	–	1.2	–	14.8	0.2
5. *Acanthocyclops vernalis*	–	26.3	5.7	25.6	–	–	–
6. *Mesocyclops leuckarti*	35.1	–	2.3	–	–	–	–
7. *Ceriodaphina reticulata*	6.9	12.2	–	–	–	–	–
8. *Simocephalus vetulus*	–	–	–	–	–	1.5	–
9. *Cyclops strenuus*	–	–	–	–	–	23.7	–
10. *Diacyclops bicuspidatus*	–	–	–	–	–	10.3	–
11. *Acanthocyclops viridis*	–	–	–	6.1	–	–	–
12. *Asellus aquaticus*	–	–	–	4.9	–	0.3	–
13. *Campthocamptus staphylinus*	–	–	–	–	–	3.8	–
14. *Eucyclops speratus*	–	–	–	–	–	2.7	–
15. *Ceriodaphnia laticaudata*	–	–	–	2.4	–	–	–
16. *Scapholeberis kingi*	1.6	–	–	–	–	–	–
17. *Alona rectangula*	–	–	–	1.2	–	–	–
18. *Oxyurella tenuicaudis*	–	–	–	1.2	–	–	–
19. *Potamocypris unicaudata*	–	–	1.1	–	–	–	–
20. *Cyclocypris laevis*	–	–	–	–	–	+	–

Note: m = scooped sample; h = sample taken with net

Table 8. The Crustacea of the open-water pondweed field

	Myriophyllum (Typha)					
	m	h	b	m	h	h
	No. 2.	No. 3.	No. 6/a.	No. 6/b.	No. 7.	No. 4/a.
	(VII. 12.)	(VII. 12.)	(VII. 14.)	(VII. 14.)	(VII. 14.)	(VII. 12.)
1. *Alona rectangula*	89.4	4.2	86.9	7.6	2.1	5.3
2. *Acanthocyclpos vernalis*	2.4	43.1	–	35.3	12.7	70.8
3. *Diaphanosoma brachyurum*	2.4	19.7	–	6.4	41.0	12.3
4. *Bosmina longirostris*	–	19.4	5.4	15.3	31.0	7.0
5. *Chydorus shpaericus*	0.8	–	6.8	2.4	3.1	1.7
6. *Arctodiaptomus spinosus*	1.6	6.5	–	–	3.1	–
7. *Ceriodaphnia reticulata*	–	0.6	–	–	0.4	1.2
8. *Ceriodaphnia quadrangula*	–	1.1	–	16.1	–	–
9. *Mesocyclops leuckarti*	–	–	–	14.5	2.2	–
10. *Simocephalus vetulus*	–	–	–	2.4	1.8	–
11. *Thermocyclops crassus*	–	5.1	0.9	–	–	–
12. *Acanthocyclops viridis*	–	–	–	–	2.6	–
13. *Nitocra hibernica*	2.4	–	–	–	–	–
14. *Moina micrura*	–	–	–	–	–	1.7
15. *Asellus aquaticus*	0.8	–	–	–	–	–
16. *Oxyurella tenuicaudis*	–	0.3	–	–	–	–

Note: m = sampling scooped from among pondweeds; h = sampling with net among pondweeds; b = pondweed coating

Table 9. Crustacea of the aquatic plants of the edge of the canals, in per cent

Species	No. 13. h. (reed-sedge) VII. 15.	No. 26. h. (pondweed-slack water) VIII. 18.
1. *Simocephalus vetulus*	61.5	32.0
2. *Macrocyclops fuscus*	–	28.0
3. *Eucyclops sperratus*	–	16.0
4. *Mesocyclops leuckarti*	15.4	–
5. *Ceriodaphnia quadrangula*	15.4	–
6. *Simocephalus v. congener*	–	8.0
7. *Scapholeberis kingi*	7.7	–
8. *Ilyocryptus sordidus*	–	4.0
9. *Acanthocyclops viridis*	–	4.0
10. *Thermocyclops dybowskyi*	–	4.0
11. *Cryptocyclops bicolor*	–	4.0

Table 10. Comparison of the Crustacea associations of the planktons, in per cent of Lakes Fertő and Balaton in identical periods

Lake Fertő	Balaton (Ponyi, 1968)
July	
Diaphanosoma brachyurum (40%)	*Diaphanosoma brachyurum* (33%)
Acanthocyclops vernalis (31%)	*Eudiaptomus gracilis* (33%)
Arctodiaptomus spinosus (22%)	*Mesocyclops leuckarti* (27%)
August	
Diaphanosoma brachyurum (45%)	*Eudiaptomus gracilis* (52%)
Bosmina longirostris (20%)	*Diaphanosoma brachyurum* (22%)
Arctodiaptomus spinosus (18%)	*Mesocyclops leuckarti* (19%)
September	
Bosmina longirostris (85%)	*Ediaptomus gracilis* (41%)
Diaphanosoma brachyurum (11%)	*Diaphanosoma brachyurum* (17%)
	Mesocyclops leuckarti (16%)

rences between the two lakes, in certain respects (e. g. shallowness, water disturbances caused by wind action), there are also numerous similar features. The latter is confirmed by the analysis of the Crustacea associations, as far as open waters are concerned.

Table 11. The Crustacea fauna of the water covered by reeds of Lake Fertő

Species	Data of							
	U h N. 5. VII. 12.	U h No. 8. VII. 14.	D m No. 9/c VII. 14.	D m No. 14. VII. 15.	D sz No. 9/a. VII. 14.	D mo No. 9/b. VII. 14.	C h No. 30. IX. 14.	P h No. 39. IV. 25.
Chydorus sphaericus	1.7	25.8	9.8	25.0	14 4	32.6	12.5	0.2
Acanthocyclops viridis	–	6.1	14.1	3.5	5.2	11.6	25.0	–
Pleuroxus aduncus	1.5	8.2	28.3	53.6	35.0	37.2	–	–
Ceriodaphnia reticulata	26.6	–	–	–	–	–	–	0.2
Daphnia curvirostris	63.2	–	–	–	–	–	25.0	98.3
Simocephalus expinosus	2.5	4.8	5.4	–	3.1	–	–	0.6
Scapholeberis kingi	–	4.8	–	–	–	–	25.0	–
Ceriodaphnia laticaudata	–	43.5	32.6	17.9	1.0	7.0	–	–
Eucyclops serrulatus	0.8	2.7	–	–	–	–	–	0.2
Scapholeberis aurita	2.2	–	3.2	–	–	2.3	–	–
Alonella excisa	–	–	2.2	–	22.7	2.3	–	–
Mesocyclops leuckarti	–	–	–	–	–	–	–	–
Cyclops strenuus	–	–	–	–	–	–	–	0.5
Eucyclops speratus	–	–	–	–	–	–	–	–
Asellus aquaticus	–	–	–	–	1.0	7.0	–	–
Acanthocyclops vernalis	–	–	4.4	–	–	–	–	–
Diaphanosoma brachyurum	0.2	0.7	–	–	–	–	–	–
Arctodiaptomus spinosus	–	–	–	–	–	–	–	–
Alona rectangula	–	–	–	–	–	–	12.5	–
Simocephalus betulus	–	–	–	–	–	–	–	–
Heterocypris salina	–	–	–	–	–	–	–	–
Potamocypris unicaudata	–	–	–	–	–	–	–	–
Simocephalus vet. v. congener	–	–	–	–	–	–	–	–
Cyclocypris ovum	–	–	–	–	13.4	–	–	–
Canthocapmtus staphylinus	–	–	–	–	–	–	–	–
Ilyocriptus sordidus	–	–	–	–	–	–	–	–
Bosmina longirostris	–	3.4	–	–	–	–	–	–
Cyclocypris laevis	–	–	–	–	3.1	–	–	–
Macrothrix laticornis	–	–	–	–	–	–	–	–
Cypris pubera	1.2	–	–	–	–	–	–	–
Leydigia acanthoceroides	–	–	–	–	–	–	–	–
Cypria ophthalmica	–	–	–	–	1.0	–	–	–
Ilyocypris bradyi	–	–	–	–	–	–	–	–
Polyphemus pediculus	–	–	–	–	–	–	–	–
Daphnia hyalina	–	–	–	–	–	–	–	–
Notodromas monacha	0.2	–	–	–	–	–	–	–

Note: U = *Utricularia;* D = *Drepanocladus;* C = *Chara;* P = reed-field; h = sample taken with net; m = scooped sample; mo = filamentous algae; sz = water filtered plants; T = pool in clearings surrounded by reeds; + = 0,1 per cent

The Crustacea of the water covered with reeds

We examined the Crustacea faunule of two types of reed-fields, out of which one is Scirpeto-Phragmitetum. This reed-zone has a stand of intensive growth and closed character. The other is Scirpeto-Phragmitetum utriculariosum which can be characterized by a mass vegetation of *Utricularia vulgaris* (TÓTH & SZABÓ, 1976). The stand mentioned second also has a form characterized by a mass vegetation of *Drepanocladus aduncus* var. *kneiffii*. It occurs in places where the water begins to disappear from under the reeds, and the *Utricularia* begins to decay.

From the water surface covered with reeds we demonstrated 35 species and 1 variety. If we compare the Crustacea associations of the two types of reeds as to frequency and percentual composition (Table 11), we shall find a difference. While of the reed-type Sc.-Ph. utriculariosum the presence of *Chydorus sphaeritus – Pleuroxus aduncus – Acanthocyclops viridis – Ceriodaphnia laticaudata,*

(The figures mean percentual composition)

ollection

P h No. 41. IV. 25.	P h No. 42. IV. 25.	P h No. 10/a. VII. 14.	P h No. 10/b VII. 14.	P h No. 16. VIII. 16.	P h No. 17. VIII. 16.	P h No. 20. VIII. 17.	P h No. 31. IX. 15.	P h No. 32. IX. 15.	P m No. 34/a. XII. 20.	P h No. 34/b. XII. 20.	T m No. 24. VIII. 18.	T h No. 29. IX. 15.
6.7	–	+	6.0	0.6	–	50.0	–	11.1	9.7	1.1	2.4	6.6
6.7	9.6	+	6.0	1.6	–	–	26.1	–	–	0.8	19.0	2.0
–	7.9	+	18.0	1.1	–	–	4.3	7.4	–	–	–	–
–	34.9	11.5	30.0	34.2	57.1	–	52.2	81.5	32.2	–	2.4	24.7
50.0	23.8	75.0	–	–	–	–	–	–	–	86.7	–	19,7
–	7.9	+	2.0	–	–	–	–	–	–	–	–	26.3
–	1.6	13.5	8.0	–	–	–	17.4	–	–	–	4.8	2.5
–	–	–	–	58.7	42.9	–	–	–	–	–	–	–
13.3	–	+	–	–	–	–	–	–	–	–	30.9	–
–	1.6	+	4.0	–	–	–	–	–	–	–	–	0.4
–	–	+	4.0	–	–	–	–	–	–	–	–	–
–	–	+	8.0	3.8	–	50.0	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	16.1	2.3	–	–
–	–	–	–	–	–	–	–	–	9.7	0.7	–	1.6
–	–	–	–	–	–	–	–	–	3.2	–	–	–
–	–	+	4.0	–	–	–	–	–	–	–	–	–
–	1.6	–	–	–	–	–	–	–	–	–	–	–
13.3	11.1	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	11.5
10.0	–	–	10.0	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	14.3	2.0
–	–	–	–	–	–	–	–	–	–	–	11.9	0.8
–	–	–	–	–	–	–	–	–	3.2	8.4	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	25.8	–	–	–
–	–	–	–	–	–	–	–	–	–	–	11.9	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	2.4	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	0.8
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	+	–	–	–	–	–	–	–	–	–	–
–	–	+	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–

of the reed-type Sc.-Ph. phragmitetosum the occurrence of *Ceriodaphnia reticulata – Chydorus sphaericus – Acanthocyclops viridis – Daphnia curvirostris* association is characteristic.

During the examinations it could be regarded as a special point of interest, that in the small "openings" of a few square metres extent of Sc.-Ph. phragmitetosum, where no undergrowth developed, we also found the Ostracoda species *Heterocypris salina* and *Potamocypris unicaudata.*

In the course of the examinations only one opportunity presented itself for simultaneously studying the composition of the Crustacea as to species along a complete cross-section (open water – pondweed-field-reeds) (Table 12). Even this examination was sufficient for proving that also in the reeds of Lake Fertő a peculiar "zones" can be formed which, however, differs from the conditions to be observed in the Balaton reeds (Ponyi, 1962). If one compares the number of Cladocera, Copepoda and Ostracoda species found in the reeds of Lakes Fertő

Table 12. Percentual distribution of the Crustacea species along the cross-section: open water — pondweed — reeds (July 12th, 1960)

Type of collecting site:	open water	open water pondweed	open water and open water pondweed together	rushy reed fringe	coating of rushes	reeds with *Utricularia*
Species Coll.p.No.	1	2	3	4/a	4/b	5
Acanthocyclops vernalis	**56,2**	2.4	**43,1**	**70,8**	–	–
Diaphanosoma brachyurum	**30,2**	2.4	19.7	12.3	–	0.2
Bosmina longirostris	8.9	–	19.4	7.0	–	–
Arctodiaptomus spinosus	4.7	1.6	6.5	–	–	–
Alona rectangula	–	**89,4**	4.2	5.3	**54,8**	–
Nitocra hibernica	–	2.4	–	–	9.7	–
Asellus aquaticus	–	0.8	–	–	–	–
Ceriodaphnia reticulata	–	–	0.6	1.2	–	**26,6**
Thermocyclops crassus	–	–	5.1	–	–	–
Ceriodaphnia quadrangula	–	–	1.1	–	–	–
Oxyurella tenuicaudis	–	–	0.3	–	–	–
Moina micrura	–	–	–	1.7	–	–
Daphnia curvirostris	–	–	–	–	–	**63,2**
Simocephalus expinosus	–	–	–	–	–	2.5
Scapholeberis aurita	–	–	–	–	–	2.2
Pleuroxus aduncus	–	–	–	–	–	1.5
Cypris pubera	–	–	–	–	–	1.2
Eucyclops serrulatus	–	–	–	–	–	0.8
Notodromas monacha	–	–	–	–	–	0.2

Note: Coll. p. = collecting places

Table 13. Comparison of the numbers of species and varieties of Cladocera, Copepoda and Ostracoda demonstrated from the reed-fields of Lakes Fertő and Balaton

Suborder or subclass	Lake Fertő (Table 11)	Balaton (Ponyi, 1962)	number of common species
Cladocera	20	20	8
Copepoda	8	18	4
Ostracoda	7	7	2
Total	35	45	14

and Balaton (Table 13), one finds that out of the 25 and 11 species, respectively, only 14 are common in both. Among others also this refers to the different character of the two lakes.

Summary

The authors studied the Crustacea in samples taken from 43 sites of collection in the Hungarian area of Lake Fertő in the years 1960–61. In the course of the examinations they demonstrated 22 Cladocera, 8 Ostracoda, 14 Copepoda and 1 Isopoda species.

Comparing their results with earlier literary data, they found that, as compared with the 1900s, a considerable exchange of species took place in the Cladocera faunule.

Out of the 11 Ostracoda species mentioned by Daday, the authors only found four. Together with the above, the "disappearance" of the genera *Cypridopsis* and *Limnocythere* refers to a considerable change of the lacustrine environment.

From among the Ostracoda species, *Potamocypris unicaudata* Schäfer is new to the fauna of Hungary. 5 Cladocera, 4 Ostracoda and Copepoda species were found to be similarly new for the fauna of Lake Fertő.

In the summer season the open-water Crustacea association is characterized by the species *Diaphanosoma brachyurum – Bosmina longirostris – Acanthocyclops vernalis – Arctodiaptomus spinosus*. In April the presence of *Chydorus sphaericus* in place of *Acanthocyclops vernalis* has a greater significance. The composition of the Crustacea association somewhat differs from that found in the open water of the Austrian part of the Lake, since in that part the summer open-water Crustacea plankton is determined by the species *Diaphanosoma – Arctodiaptomus*.

The open-water pondweed field can be characterized by the *Alona rectangula – Acanthocyclops vernalis – Diaphanosoma brachyurum – Bosmina longirostris* Crustacea association.

In the two different reed-fields the authors found different associations of Crustacea. Of Scirpeto–Phragmitetum phragmitetosum the joint occurrence of *Ceriodaphnia reticulata – Chydorus sphaericus – Acanthocyclops viridis – Daph-*

nia curvirostris is characteristic; — of the type, Sc.-Ph.-Ph. utriculariosum the Crustacea association: *Chydorus sphaericus — Pleuroxus aduncus — Acanthocyclops viridis — Ceriodaphnia laticaudata* is characteristic.

REFERENCES

1. Andrikovics S. & Berczik Á. (1975): *Hidrobiológia — zoológia.* — In: A Fertő-táj Monográfiát előkészítő adatgyűjtemény 3. Természeti adottságok: A Fertő-táj bioszférája, Kézirat. VITUKI, 423–436.
2. Andrikovics S. & Berczik Á. (1975 *a*): *Állattani adatgyűjtemény (körszájúak, halak és madarak nélkül).* In: A Fertő-táj Monográfiát előkészítő adatgyűjtemény 3. Természeti adottságok: A Fertő-táj bioszférája. Kézirat. VITUKI, 437–537.
3. Balogh J. (1953): *A zoocönológia alapjai. (Grundzüge der Zoozönologie.)* — Akadémiai Kiadó, pp. 248.
4. Daday J. (1890): *A magyarországi Diaptomus-fajok átnézete. (Conspectus Diaptomorum faunae Hungariae.)* — Természetrajzi Füzetek, 13: 114–180.
5. Daday J. (1891): *Adatok Magyarország édesvízi mikroszkópos faunájának ismeretéhez.* — Természetrajzi Füzetek, 14; 16–31.
6. Daday J. (1897): *A magyarországi tavak halainak természetes tápláléka. (A magyarországi tavak mikroszkópi állatvilága.)* — A Kir. Magyar Term. tud. Társulat, Budapest, pp. 481.
7. Daday J. (1900): *A magyarországi kagylósrákok magánrajzu. Ostracoda Hungariae.* — MTA. Budapest, pp. 320.
8. Farkas H. (1958): *Kagylósrákok, Ostracoda.* — In: Magyarország Állatvilága, IV, 3, Akad. Kiadó, Budapest, 2–68.
9. Iharos Gy. (1964): *A balatoni nádasok bevonatának Tardigradái. (Die Tardigraden des Peri-phyton der Röhrichte im Balaton–See.)* — Állatt. Közlem., 51: 49–53.
10. Imhof G. (1966): *Ökologische Gliederung des Schilfgürtels am Neusiedler See und Übersicht über die Bodenfauna unter produktionsbiologischen Aspekt.* — Sitz. ber. Österr. Akad. Wiss., math.-nat. Kl. Abt. I, 175: 219–235.
11. Lászlóffy W. (1972): *A Fertő-táj bibliográfiája. (Bibliographie des Neusiedlersee-Gebiete.)* — Győr-Sopron Megyei Tanács, Győr, pp. 294.
12. Löffler, H. (1957): *Vergleichende limnologische Untersuchungen an den Gewässern des Seewinkels (Burgenland). I. Der winterliche Zustand der Gewässer und deren Entomostrakenfauna.* — Verh. Zool.-Bot. Gesell. in Wien, 97: 27–52.
13. Löffler, H. (1974): *Der Neusiedlersee. Naturgeschichte eines Steppensees.* — Verl. F. Molden, Wien–München–Zürich, pp. 175.
14. Manujlova, E. F. (1964): *Vetvisztouszüe racski (Cladocera).* — Fauna Sz. Sz. Sz. R., Izdat. Nauk., Moszkva–Leningrád, 88: pp. 326.
15. Pesta, O. (1954): *Studien über Entomostrakenfauna des Neusiedler Sees.* — Wiss. Arb. Bgld., Eisenstadt, pp. 84.
16. Ponyi J. (1956): *A balatoni hínárosok Crustaceáinak vizsgálata. (Untersuchungen an Crustaceen in Tanggebilden des Balatons).* — Állatt. Közlem., 45: 107–121.
17. Ponyi, J. E. (1962): *Zoologische Untersuchung der Röhrichte des Balaton I. Krebse (Crustacea).* — Annal. Biol. Tihany, 29: 129–163.
18. Ponyi, J. E. (1968): *Studien über das Crustaceen-Plankton des Balaton IV. Beiträge zur Kenntnis der in der Krebsgemeinschaft des Sees horizontal auftretenden Veränderungen.* — Annal. Biol, Tihany, 35: 169–182.

19. Ponyi, L. (1965): *Zoologische Untersuchungen der Röhrichte des Balaton II. Wassermilben (Hydracarina).* – Annal. Biol. Tihany, 32: 175–186.

20. Schäfer, H., W. (1943): *Über zwei neuen deutsche Arten der Süsswasser-Ostracoden.* – Zool. Anz., 143: 210–216.

21. Šrámek–Hušek, R. M. Straskraba & J. Brtek (1962): *Lupenonožci Branchiopoda.* – Fauna CSSR, S. 16, Ceskoslov. Akad. Věd, Praha, pp. 470.

22. Szabó E. (1962): *A Fertő tó vizének kémiai tulajdonságai.* – Hidrol. Tájékoztató, December, 146–150.

23. Tóth, L. (1960): *Phytozönologische Untersuchungen über die röhrichte des Balaton–Sees.* – Annal. Biol. Tihany, 27: 209–242.

24. Tóth, L. (1960/a): *A Fontinalis antipyretica L. cenológiai szerepe a Balaton nádasaiban.* – Hidrol. Közlem., 2: 164–166.

25. Tóth, L. & E. Szabó (1961): *Zönologische und ökologische Untersuchungen in den Röhrichte des Neusiedlersees (Fertő-tó).* – Annal. Biol. Tihany, 28: 151–168.

26. Wagler, E. (1937): *Crustacea, Krebstiere,* in: Tierwelt Mitteleuropas, II, 2, pp. 224.

27. Zakovsek, G. (1961): *Jahreszyklische Untersuchungen am Zooplanton des Neusiedlersees mit Berücksichtigung der meteorologischen und chemischen Verhältnisse.* – Wiss. Arb. Bgld., Eisenstadt, pp. 85.

Table 3. Copepoda species demonstrated up to now from Lake Fertő

Species	t. s.	Daday	Pesta	Zakovcek	Ponyi and Dévai
		1890 – 1892	1950 1952	1950 – 1952	1960 – 1961
	i. d. p.	1890 1891 1897	1954	1961	1976
1. *Eudiaptomus vulgaris* (Schmeil)		+	–	–	–
2. *Arctodiaptomus bacillifer* (Koelbel)		–	–	+	–
3. *Arctodiaptomus spinosus* (Daday)		+	+	+	+
4. *Mixodiaptomus kupelwieseri* (Brehm)		–	+	+	–
5. *Macrocyclops albidus* (Jurine)		+	–	–	–
6. *Macrocyclops fuscus* (Jurine)		–	+	+	+
7. *Eucyclops serrulatus* (Fischer)		+	+	+	+
8. *Eucyclops speratus* (Lilljeborg)		–	+	–	+
9. *Paracyclops fimbriatus* (Fischer)		+	–	–	–
10. *Cyclops strenuus strenuus* (Fischer)		+	+	+	+
11. *Acanthocyclops (Acanthocyclops) vernalis* (Fischer)		–	+	+	+
12. *Acanthocyclops (Megacyclops) viridis viridis* (Jurine)		+	+	+	+
13. *Diacyclops bicuspidatus* (Claus)		–	+	+	+
14. *Diacyclops nanus* (G. O. Sars)		+	–	–	–
15. *Cryptocyclops bicolor* (G. O. Sars)		–	+	+	+
16. *Microcyclops varicans* (G. O. Sars)		–	+	+	–
17. *Mesocyclops leuckarti* (Claus)		+	+	+	+
18. *Thermocyclops crassus* (Fischer)		–	+	–	+
19. *Thermocyclops dybowskii* (Landé)		–	–	–	+
20. *Nitocra hibernica* (Brady)		–	–	–	+
21. *Canthocamptus staphylinus* (Jurine)		+	+	–	+
22. *Attheyella (Mrázekiella) trispinosa* (Brady)		–	+	–	–

Key to the abbreviations: t. s. = time of sampling; i. d. p. = imprint date of the publication

Löffler's (1974) book. Out of the 11 species demonstrated by Daday we could only find four. The present absence of the genera *Cypridopsis* and *Limnocythera* may similarly be indicative of some degree of change of the environment.

Out of the Ostracoda species, *Potamocypris unicaudata* Schäfer proved new for the fauna of Hungary. This species was described by Schäfer (1943) from of the lagoons of the Kiel bay (Barsbeker Lake), as well as from a canal which was in direct connection with the Baltic Sea. In the former site specimens turned up from the coating of reeds, in the latter one from that of piles. As to salt content, both sites of collection belonged to the oligohaline type, their NaCl content per litre was 396 – 709 mg, which means that the Cl^- content was below 300mg/litre. In Lake Fertő this species was found in collecting sites No. 23, 24 and 29, where the Cl^- content was 246 mg/litre (Table 5).

Löffler (1957) found *P. unicaudata* in some of the pools of "Seewinkel", where the Cl^- content was below a value of 50 mg/litre.

As shown by our examinations, since Daday the number of species of the Copepoda shows a rising tendency (Table 3). While Daday mentioned 10 species,

Opusc. Zool. Budapest, XVI, 1–2, 1979

Difference of Responsiveness of the Great Tit, Blue Tit, and Marsh Tit to Acoustic Stimuli

By

L. Sasvári*

Abstract. The main purpose of the experiments of acoustic play-back carried out under natural conditions was to compare the acoustic responsiveness of three species of tits: *Parus maior*, *P. caeruleus* and *P. palustris*. Each form of signals (attracting call, alarm call, anxiety call, aggressive call, territory song) exerted in a certain per cent of the observed cases an attracting effect. The repetition of the sound signals independently of their specific function, exerts an attracting effect (approaching in the perceiving birds), and that the specific structural, pitch, timbre etc. properties of sound signals express the concrete social drives and physiological condition (gregarious attraction, reproductive aggressivity, the gathering round the sitting predator, etc.) of the individuals.

The responsiveness of the great tit is higher than those of the blue and marsh tits. At times the great tit responded to the signals of the two related species more sensitively than the latter did to the conspecific signals. Building its nests in urban-industrial environment, and better adapting itself to the extreme human effects, the great tit is a progressive species as compared with the blue and marsh tits, and this ability is in part determined by its higher responsiveness to acoustic signals.

Acoustic experiments carried out under natural conditions spread in the last decades as specific research methods in ornithology. H. and M. Frings, J. Jumber, R. Busnel, J. Giban and P. Gramet (1958) opened the series of the known experimenters by comparing the responses of the *Corvus* and *Larus* species of America and France by acoustic play-backs. J. B. Falls (1963) carried out various modifications on the structural characteristics of the territory song, and examined in this way the effect of the signals eliciting responses. R. E. Lemon (1969) and M. A. Harris (1974) studied the similar geographic dialects of various North American species by means of acoustic play-backs, P. Marler and R. A. Stefanski (1972), as well as E. Curio (1971) and W. Fleuster (1973) examined the interspecific effect of alarm calls in a similar way. G. Thielcke (1970, 1971) studied the mutual responses of the tree and short-toed tree creepers as sympatric species to the songs of one another, and made, in his conclusions, statements about the evolutionary significance of learning. R. M. Evans (1970), J. R. Stevenson (1970) and S. T. Emlen (1971), 1972) studied by acoustic experi-

* *Dr. Lajos Sasvári*, ELTE Állatrendszertani és Ökológiai Tanszék (Zoosystematical and Ecological Institute of the Eötvös Loránd University), 1088 Budapest, VIII. Puskin u. 3.

ments the instances of individual recognition taking place upon vocal signals. M. SCHUBERT (1971) and H. W. HELB (1975) examined the conncection of and the reaction to the territory song with same method. As regards tits, G. THIELCKE (1969) carried out acoustic experiments with various *Parus ater* and *Parus maior* subspecies and K. L. *Dixon* and STEFANSKI (1970) with the North American *Parus atricapillus*. Unlike the investigations of the above researchers, the aim of my experiments was first of all to compare the responsiveness of the three tit species representing the same genus *(Parus maior, P. caeruleus* and *P. palustris)*.

Method

Between 1966 and 1975 I studied the social dinamics in a population of great, blue and marsh tits near Budapest. (On that work I reported in the Opuscula Zoologica under the title: "Social dinamics in populations of great tit, blue tit and marsh tit.") I determined the dispersion of the tits by playing back the most effective acoustic attracting signals: anxiety churrings; namely, when perceiving these signals, the individuals marked with coloured rings gathered round the loud-speaker placed in different points of the studied area. In the course of my investigations, however, I could register only the effect of the anxiety calls, so that I could survey responsiveness also experiments with other signals were necessary. Therefore I also carried out experiments with the attracting calls and territory songs of all three species, as well as with the alarm call of the great tit and with the aggressive call of the marsh tit.

In Figures 1 – 11 I illustrate the signals played back in the course of the experiments in a visual representation corresponding to the perceived sounds. *The sounds function as signals perceived as stimuli of various pitches*, consequently, I also study the nature of the sounds as *perceived* signs and also represent them accordingly. Complying with the physiological-anatomical analogy, the sound perception of the birds is vasically identical with the one of man, therefore I represent the signals played back in the course of the experiments with an objective recording and analysing method of perceiving human sound emission, with the one of musical notation which adequataly reflects the perceived pitch. Since the majority of the calls of the tits are gliding sounds passing through several pitches, and stabilitated pitches are few, for scoring the pitch not the representation by note heads but that by sound curves was to the purpose. For uniformity's sake I illustrate also the stabilitated pitches (e. g. the territory song of the great tit) by sound lines. The tremolos consisting of series of short sound elements, which are to be heard naturally trembling and rasping, I denoted with series of tiny dots. The signals sounding simultaneously in two parts I represent by sound lines drawn above and below one another. (Both of these forms of representation only occur with anxiety calls.) By means of the symbol system applied in the representation one may transform the visual picture into an audile one; however, for this also the key to the signs should be thoroughly studied. The Figures show sounds slowed down, extended in time since, in this way even naturally rapid changes in pitch, indistinctive for the human ear can be perceived in detail and so the sound structure can be analysed. The structural analysis and representation of the sounds were done by Mrs. ZSUZSA SASVÁRI. In the experiments I used UHER 4000 Report – L tape recorder and Orion Ritmus loud-speaker.

I carried out the experiments in the autumn and winter months, when the tits formed mixed flocks. However, in too cold weather (under Hungarian weather conditions below − 5°C) and in heavy fog I never did experiments, because then social cohesion became intense within the mixed groups, the drive of following one another was highly increased, and the reaction of approaching the loud-speaker of one or two individuals elicited responses also on the part of the others. Thus in such cases it was difficult to differentiate actual responsiveness to sound stimuli from responsiveness to the visual stimuli denoting the companions. Again, in other instances the flocks proceeding in close formation went past the source of sound without one of the individuals having responded, since the leading birds of the flock were indifferent to the sound signals and swept along with themselves all their companions. Still, such a situation, i. e. a too close social attachment and a mobility increased together with it was relatively infrequent. Generally, in the areas where I performed the experiments (on the outskirts of settlements, near farm buildings), although all three species formed mixed groups, their mobility was low on account of the abundance of food; neither did they show an intense following reaction towards in another. As a consequence, the number of individuals of the small groups showed hardly any change. I carried out the experiments in 10 different areas (all of them in the environs of Budapest) with 10 different groups of tits. In the groups the number of individuals of great tits varied between 17 – 25, that of the blue tits between 8 – 14 and that of marsh tits between 6 – 9.

During one experimental event I played back 11 different forms of signals, i. e. all three species could perceive their own specific sound signals and also those of the other two related species. The signals belonging to one species followed one another in one group, I did not alter their sequence in the course of the experiments. Thus the sound signals of the three species were divided into three separate groups, and I changed only the succession of these during the experiments (see Fig. 2). In this way the sound signals of each of the three species sounded at the beginning and in the middle and at the end of the experimental processes. This alteration was necessary so that responsiveness decreasing with the advance of the experiment should not at all times refer to the same sound forms. In one site (that is, with one group of tits) I experimented only on three occasions, i. e. I played back the three forms of sequences on one occasion each. After the autumn experiments I repeated all this in the same way in the same places also in winter.

I played back all signals with 3 seconds' intervals for 4 – 5 minutes. Between the play-backs of the different signals I made 10 – 20 minutes pauses, longer ones when some individuals of the group of tits moved too far away from the loud-speaker. During the play-backs of the voices the tits were 20 – 60 metres off the loud-speaker, and their approach to it I considered a positive reaction. I carried out the experiments at identical parts of the day, between 7 – 13°° a.m. In autumn the temperature was, generally, +10° – 0° C, in winter 0° – −5 °C; windy weather I made no experiments.

Since during the experiments the proportion of individuals of the three species was unequal, I expressed the measure of the responses at all times as the percentage of the individuals approaching the loud-speaker compared to the individuals of the same species who perceived all sound signals. Further, as I played back all three signal sequences in 10 different areas to 10 different groups of tits,

Visual representation of the acoustic signals played back in the course of the experiments

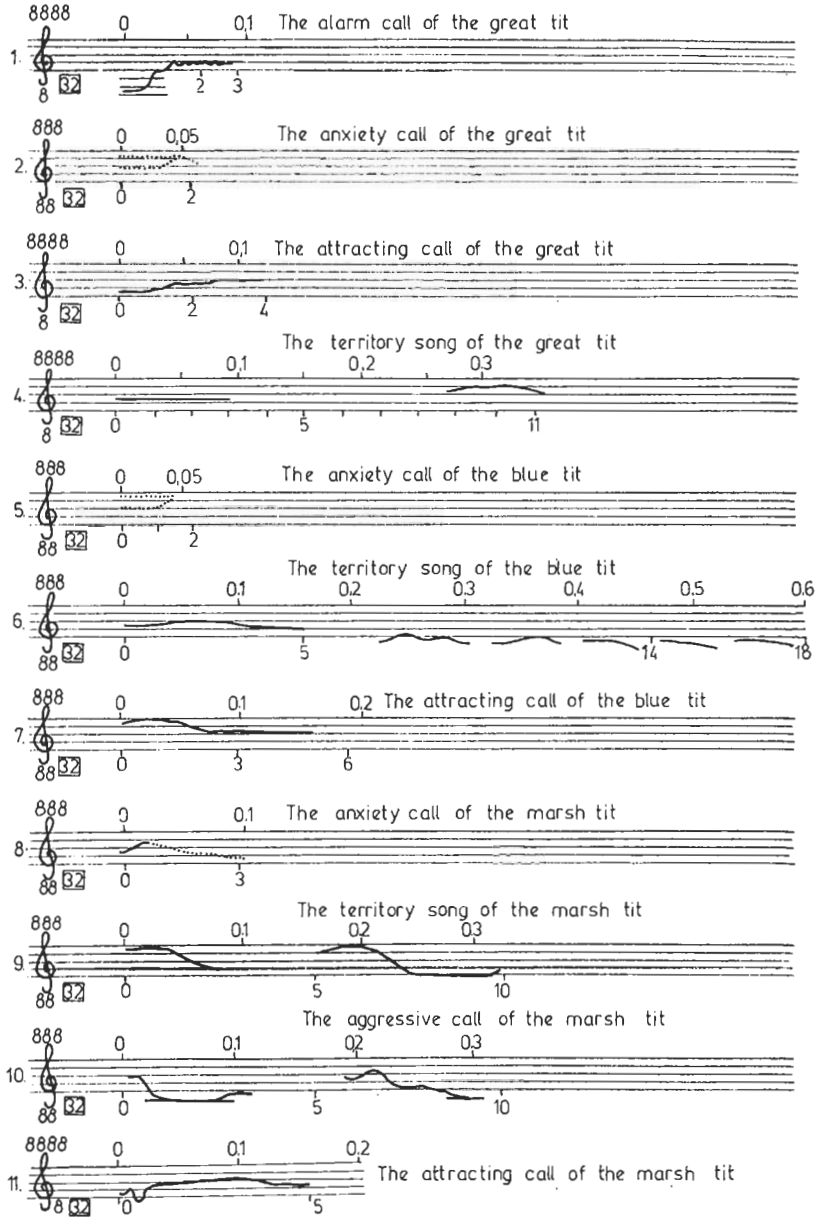


Fig. 1 – 11. Notes: 32 means that the natural duration is extended (i. e. the speed slowed down) 32 times. 8888 and 888, above the clef mean that the natural pitch is higher by 4 and 3 octaves, respectively, than notated. – 8 and 88 below the clef mean that the pitch of the slowed down play back, as a basis of graphic representation, is lower by 1 and 2 octaves, respectively, than notated. – The calibration in second above the five-line staff shows the natural duration of the sounds, while the one below the five-line staff their slowed down duration extended 32 times.

the data presented in Fig 12 and 13 reflect the average result of 10 experiments relying upon the above percentual evaluation. The lowermost part of the Figure shows – disregarding the succession of the sounds played back – a further averaging of the data, i. e. that, relying upon all experiments, which of the signals elicited a response and in what measure in autumn and winter.

Results

I. Generally, the value of the responses elicited by the signals decreased with the advance of the experiments; i. e. to the same sound stimuli less individuals responded towards the end of the play-back process than at its beginning; still, the difference was not significant. Evidently, the tits perceiving the repeated sound stimuli became in some measure accustomed to them, and it could be ascribed to the shorter or longer pauses, as well as to the different forms of the signals that they did not become indifferent to the voices. The decrease, extinction or revival of responsiveness I could have studied only if I had played identical sound signals to the same individuals, repeated at certain intervals; still, under the given circumstances I could not do this examination. (Individually marked tits were to be found only in the experimental areas, where I also studied the population dynamic processes.).

Comparing the experiments carried out in autumn and winter one can find that in the two seasons there is no significant difference in the responsiveness of the tits. This finds its explanation in the circumstance that I carried out experiments in an essentially identical social environment, in individuals of identical social drives.

In all three species the most intense response was elicited by anxiety churring. (In the course of the population dynamic investigations the tits showed response values of $90-100\%$ to that signal, as only that call was being sounded then, and the responsiveness of the individuals was not decreased previously by any other signal). Next to this the territory song elicited relatively frequent responses then, upon the attracting call the tits approached the loud-speaker less. The responses to aggressive calls of the marsh tit surpassed that to the attracting calls and, in some per cent of the experiments even the alarm call of the great tit exerted an approaching effect.

II. When comparing the reaction lines of the three species of tits it is conspicuous that, on an average, that of the great tit is much higher than those of the blue and marsh tits. Consequently, the great tit responded much more sensitively to the signals of its own species than did the other two species to similarly conspecific signals. Only the responses elicited by the attracting calls were exceptions in this respect; all three species responded, namely, in an approximately identical proportion to such calls of the identical species. The responsiveness to conspecific signals of the blue and marsh tit did not show significant differences.

It clearly appears from the lines of reaction represented in the Figures that the sensitivity of the great tit was high not only to conspecific signals, in certain instances even its responses to the signals of the blue and marsh tits came near to or even surpassed the ones of the related species to their conspecific signals. This is what can be stated on the values given for the attracting call and anxiety

The responsiveness of the great tit, blue tit and marsh tit in the autumn period

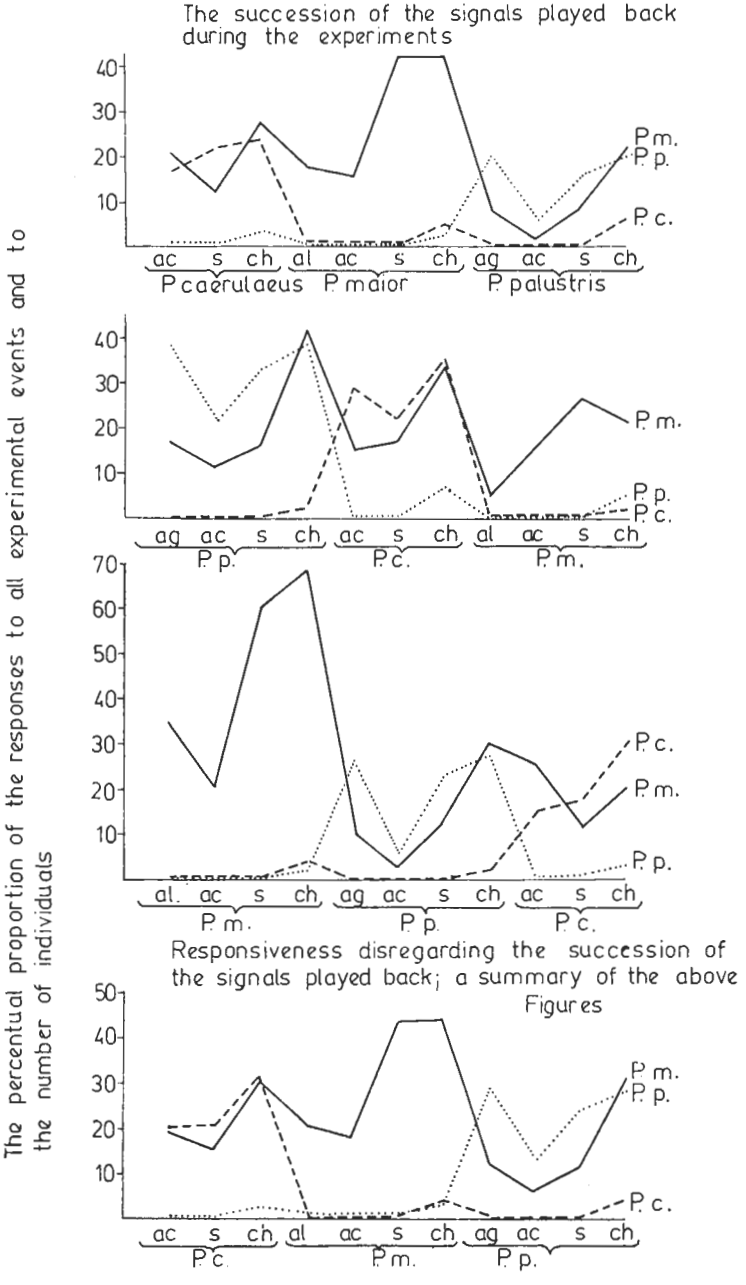


Fig. 12.

churring of the blue tit and for the anxiety call of the marsh tit. At the same time, the blue tit showed but very slight sensitivity of reaction to the signals of the great and marsh tits, even that only to thier anxiety calls and, in winter, to the attracting call as well as territory song of the great tit. The same can be found when evaluating the responsiveness of the marsh tit, i. e. that species responded in an insignificant measure to the anxiety churring of the great and blue tits, and in winter, to the territory song of the great tit.

The attracting calls of both the great and blue tit are simple gliding calls (Figures 3 and 4), the difference in them rather refers only to their timbres. The fundamental similarity of structure could give reasons why the great tit reacted with an approaching response to the attracting calls of the blue tit, however also the blue tit should respond in an approximately identical proportion to the attracting call of the great tit. There is a certain common feature also in the songs of the great tit and marsh tit insofar as both species build up their songs by frequently repeated a relatively simple sound construction, (the difference is that the great tit repeats musical intervals, and the repetitions of the marsh tit are constructions built up of gliding sounds, – see Figures 4 and 9), still, in this way both species should similarly show an approximately identical responsiveness to the sounds of one another. The same holds for the aggressive signal of marsh tit since in its construction this signal comes very close to the song of this bird (Figures 9 and 10). Among the acoustic signals of the three species difference is least in the anxiety churrings. The structure of these is almost fully identical, the only difference is that, in the course of the frequent repetition, the blue tit raises the last churring sounds to a somewhat higher pitch, and the marsh tit also inserts sharp cries between the tremolos (Figures 2, 5 and 8 – the sharp cry of the marsh tit is not presented). In the blue and marsh tits the anxiety churring elicited a response to the signals of the related species too, – even this reaction was by far inferior to the values of those shown by the great tit to the anxiety calls of the blue and marsh tits.

Discussion

I. In a certain per cent of the cases all types of acoustic stimuli elicited identical responses of locomotion during the experiments, i. e. the birds flew in the direction of the source of sound. The frequency, at which this response ensued to the single types of signals was determined by the specific structure of the signals in question. In fact, sounds perceived from the same direction and being repeated many times elicited, in certain instances, an attractive reaction even if they were alarm calls. Under natural conditions the alarm calls are being repeated once or two times, in infrequent instances three times, and thus elicit escape. An effect contrary to this ensued in consequence of frequent repetition.

That a repetition of signals brought about in a situation which differed from the natural ones elicited approach even in the case of call of repelling effect, is only possible if, *on account of the lasting repetition, the acoustic signals of this kind separate from their specific meaning, the differentiated information content based on their structure is pushed into the background and, as repeating impulses, they elicit a reaction of approaching in the perceiving individuals. Consequently, by this general function the voices ensure the maintenance of contact without concretely expressing*

The respensiveness of the great tit, blue tit and marsh tit in the winter period

The succession of the signals played back during the experiments

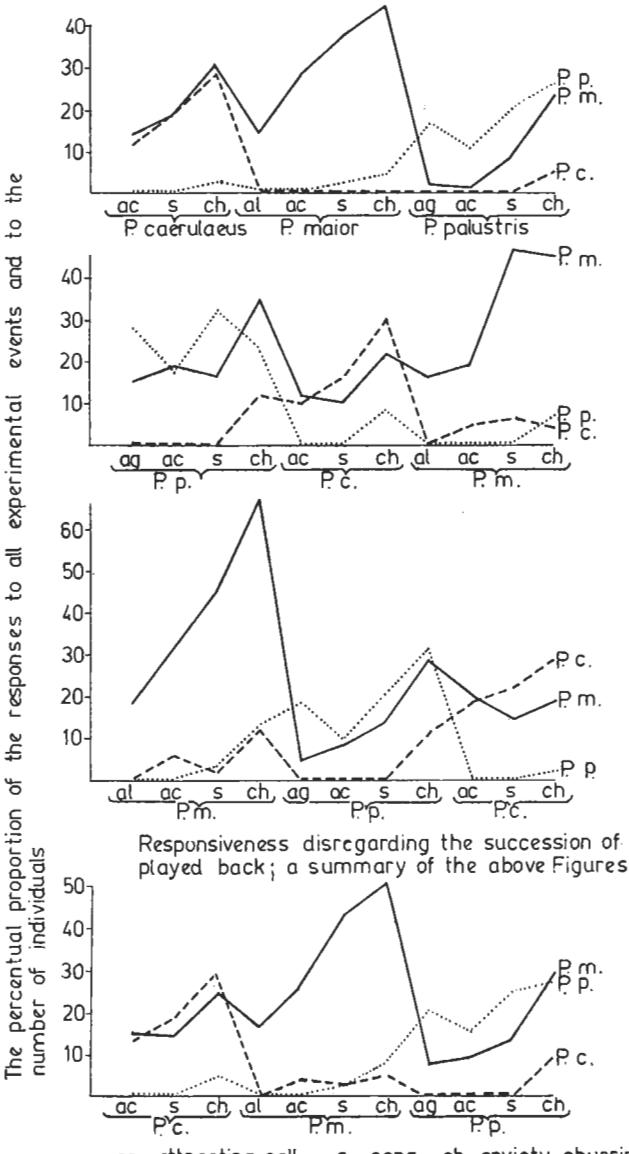


Fig. 13.

the individual relations in which exerted their attracting effect. The concrete relations are expressed by the specific sound structure. Only in this way can structurally separated and also functionally differentiated (in case of the alarm call: opposite) signals (songs, anxiety call, attracting call etc.) elicit an identical effect: that of approaching. Probably, when the alarm signals produced an attracting effect, the drive for social integration was operating with the highest intensity.

The tits staying within the range of audibility were attracted most by anxiety churring, since it was the reproduction of the anxiety churring that came nearest to the natural signalling processes. (Under natural circumstances, if the disturbing object – e. g. a sitting predator – does not change its place or moves but slowly, the sound signals of the perceiving bird, heard from the same direction and repeated for a long time gather the tits staying within the range of audibility.) What has been said in this paper about the alarm signals, is best supported by the structure of the anxiety call, as, in its specific construction this signal is essentially nothing else but a series of tiny sound elements repeated many times without vertically structure of pitch. As acoustic repetition this tremolo signal became connected with the necessity of the biologically most important situation: that of danger, in the evolution of acoustic communication. Thus it can be understood why out of the signals this one has the most intensive social function, and why, by sounding it, the individuals perceiving disturbing phenomena or objects, set in action a common social attitude.

The attracting effect of the territory songs can similarly be explained by multiple repetition, even if the process of singing does not consist of a series of identical pitches, but of identical repetition of structural units built up of various pitches. At breeding seasons it is upon the effect of the song that the male individuals get near one another and in the course of the ensuing aggressive behaviour they clear their relations of force and fix the borders of their territories. So the males use the attracting effect of the sound signals as a means of meeting each other and of dividing the nesting area among one another. The generally taken attracting effect of repetition was well supported by the experiments carried out with the song, since at the time of the experiments (autumn and winter) the reproductive behaviour, attached to the forms of signals was not present in the individuals, still, these signals often elicited a reaction of approaching.

The attracting effect of the attracting calls was lower than the one of the songs. The birds moving in pairs or in flocks repeat their attracting calls several times, but at the same time they permanently change their places, so that this sound never gives rise to a gathering of the birds. Yet, in part of the experiments, the sounds emitted from a fixed source elicited an attracting effect in the tits within the range of audition. Thus, by way of summing up what has been said above, it has to be stated, that the repetition of the sound signals, independently of their specific function, exerts an attracting effect, and that the specific structural, pitch, timbre etc. properties of the sound signals express the concrete social drives and physiological condition (gregarious attraction, reproductive aggressivity, the gathering round the sitting preadator, etc.) of the individuals.

II. The experiments have unambiguously proved that the responsiveness of the great tit is higher than that of the blue or marsh tits, since it has responded more sinsitively than the other two not only to the conspecific signals, but at times even to the signals of the two related species than they did themselves to

the conspecific signals. The increased sensitivity to acoustic signals expresses an increased social tendency, and helps in this way in the biologically advantageous joining in groups.

In the course of the social dynamic events taking place in the local populations part of the individuals of tits are driven out of the community, and forced to settle new areas. Settling in the new areas is facilitated by social attracting effects, since the pioneers increase the number of individuals round themselves by social attraction. In other cases, if more than one individual take possession of the that far untouched area at the same time, it is similarly the existing social connections that enable them to settle in the new area. At times the new area may also be a new ecological milieu, of which the actual occupation can ensue only by the formation of a stable nesting population. All this rests upon the social connections which efficiently act under the new living conditions. Still, social connections can come into existence only through well-functioning means of communication; and the more receptive is a species to the stimuli ensuring communication, the more sure and manisided is also its social life. The increased sensitivity to acoustic stimuli, which is thus the originator and also the safeguard of intensive social connection, is at the same time a means of the expansion and progression of species. Presumably, this relation also exists in the case of the great tit. In the course of its occupying to the urban environment, the great tit populates a new ecological milieu; the blue tit does this only in a moderate degree as it nests only in extensive parks, and the marsh tit does not nest in city or industrial environment at all. *The progressive effort, by which the great tit surpasses the blue and marsh tits is founded partly upon its faculties of behaviour. One of these faculties is its increased responsiveness to acoustic stimuli, which at the same time means an increased social sensitivity and is also of help in settlement new adaptive areas.* The minor social sensitivity of the blue tit and marsh tit is presumably related to the more restricted adaptation capability of these two species. Possibly behind the great tit's increased responsiveness to acoustic signals there is a comprehensive ability being manifested in general in an increased sensitivity to stimuli. This makes possible that the new constellations of stimuli should elicit approaching in the bird, and at the same time furthers a progressive moment, the settlement in the new ecological areas.

REFERENCES

1. Curio, E. (1971): *Die akustische Wirkung von Feindalarmen auf einige Singvögel.* – Journ. Ornithologie, 112 (4): 365 – 372.
2. Dixon, K. L. & Stefansky, R. A. (1970): *An appraisal of the song of the black-capped chickadee.* – Wilson Bulletin, 82 (1): 53 – 62.
3. Emlen, S. T. (1971): *The role of song in individual recognition in the Indigo Bunting.* – Z. Tierpsychologie, 28: 241 – 246.
4. Emlen, S. T. (1972): *An experimental analysis of the parameters of bird song eliciting species recognition.* – Behaviour. 41: 130 – 171.
5. Evans, R. M. (1970): *Parental recognition and the "mew call" in black-billed gulls (Larus bulleri).* Auk, 87 (3): 503 – 513.
6. Falls, J. B. (1963): *Properties of bird song eliciting responses from territorial males.* – The Proceedings XIII. th International Ornithological Congress: 259 – 271.

7. Fleuster, W. (1973): *Versuche zur Reaktion freilebender Vögel auf Klangattrappen verschiedener Buchfinkalarme.* – Journ. Ornithologie, 114 (4): 417–428.

8. Frings, H., Frings, M., Jumber, J. Busnel, R., Giban, J. & Gramet, P. (1958): *Reactions of american and french species of Corvus and Larus to recorded communication signals tested reciprocally.* – Ecology, 39 (1): 126–131.

9. Harris, M. A. & Lemon, R. E. (1974): *Songs of Song Sparrows: reactions of males to songs of different localities.* – Condor, 76 (1): 33–44.

10. Helb, H. W. (1975): *Änderungen des Informationsgehalts im Gesang des Fitis (Philloscopus t. trochilus) durch akustisch stimulierte Rivalität.* – Gustav Fischer Verlag, Stuttgart.

11. Lemon, R. E. (1969): *Effects of song tutoring and acoustic isolation on the song repertoires of cardinals.* – Animal Behaviour, 17: 523–533.

12. Marler, P. – Hamilton, W. J. (1968): *Mechanism of animal behaviour, New York.*

13. Sasvári, L. (1971): *Responsiveness of the Great Tit to different vocal stimuli.* – Acta Zool. Acad. Sci. Hung., 19 (1–2: 155–166.

14. Schubert, M. & Oehler, J. (1970): *Zur Reaktionsweise einiges Zeisigs (Carduelis spinus L.) auf gefilterte Kontaktrufe.* – Experientia, 26: 898–899.

15. Schubert, M. (1971): *Untersuchungen über die reaktionsauslösenden Signalstrukturen des Fitis-Gesanges, Phylloscopus t. trochilus und das Verhalten gegenüber arteigenen Rufen.* – Behaviour, 38 (3–4): 250–288.

16. Schubert, G. (1971): *Experimentelle Untersuchungen über die Artkennzeichnenden Parameter in Gesang des Zilpzalps. Phylloscopus c. collybia (Vieillot).* – Behaviour, 38 (3–4): 289–314.

17. Stefanski, A. & Falls, J. B. (1972): *A study of distress calls of song, swamp white-throated sparrows (Aves: Fringillidae).* – Canad. Journ. Zool. 50 (12): 1501–1525.

18. Stevenson, J. G. (1970): *Individual recognition by auditory cues in the common tern (Sterna hirundo).* – Nature, 226: 562–563.

19. Szőke, P. & Filip, M. (1972): *Inadequacy of sound spectrography to the study of intonation in bioacoustics.* – Musaica, 23: 121–144.

20. Thielcke, G. (1969): *Die Reaktion von Tannen- und Kohlmeise auf den Gesang nahverwandter Formen.* – Journ. Ornithologie, 110/2/: 147–157.

21. Thielcke, G. (1970): *Lernen von Gesang als möglicher Schrittmacher der Evolution.* – Z. Zool. Syst. Evolutionsforschung, 8: 309–330.

22. Weeden, J. S. & Falls, J. B. (1959): *Differential responses of male oven birds to recorded songs of neighbouring and more distant individuals.* – Auk, 76: 343–351.

Table 1. Significance relating to the difference of responsiveness

Acoustic signals played back in the experiments	The responsiveness of the blue tit is higher than that of the marsh tit	The responsiveness of the blue tit is higher than that of the great tit	The responsiveness of the marsh tit is higher than that of the blue tit	The responsiveness of the marsh tit is higher than that of the great tit	The responsiveness of the great tit is higher than that of the blue tit	The responsiveness of the great tit is higher than that of the marsh tit
Territory song in autumn	–	–	–	–	$p<0.001$	$p<0.001$
of the great tit in winter	–	–	–	–	$p<0.001$	$p<0.001$
Anxiety call in autumn	–	–	–	–	$p<0.001$	$p<0.001$
of the great tit in winter	–	–	$p<0.50$	–	$p<0.001$	$p<0.001$
Attrackting call in autumn	–	–	–	–	$p<0.001$	$p<0.001$
of the great tit in winter	$p<0.30$	–	–	–	$p<0.001$	$p<0.001$
Territory song in autumn	$p<0.001$	$p<0.50$	–	–	–	$p<0.01$
of the blue tit in winter	$p<0.001$	–	–	–	–	$p<0.001$
Anxiety call in autumn	$p<0.001$	–	–	–	–	$p<0.001$
of the blue tit in winter	$p<0.001$	$p<0.50$	–	–	–	$p<0.001$
Attrackting call in autumn	$p<0.001$	–	–	–	–	$p<0.001$
of the blue tit in winter	$p<0.001$	–	–	–	–	$p<0.001$
Territory song in autumn	–	–	$p<0.001$	$p<0.05$	$p<0.001$	–
of the marsh tit in winter	–	–	$p<0.001$	$p<0.05$	$p<0.001$	–
Anxiety call in autumn	–	–	$p<0.001$	–	$p<0.001$	–
of the marsh tit in winter	–	–	$p<0.01$	–	$p<0.001$	–
Attrackting call in autumn	–	–	$p<0.001$	$p<0.10$	$p<0.10$	–
of the marsh tit in winter	–	–	$p<0.001$	$p<0.20$	$p<0.05$	–

Cantacaderinae Collected by the Hungarian Expeditions to West Afrika with Some Notes on Cantacaderinae (Heteroptera, Tingidae)

By

J. M. ŠTUSÁK*

Abstract. The material of 70 specimens of Cantacaderinae collected in Ghana and the Republique du Congo is studied. *Cantacader angustecostatus* sp. n. is described from Ghana and reported from the Congo Republic. *C. hulstaerti* SCHOUT. and *C. clairi* SCHOUT. are newly recorded from Ghana and the Congo Republic, *C. afzelii* STAL and *Phatnoma maynei* SCHOUT. are new to the Congo Republic. The occurrence of *C. tenuipes* STAL (incl. var. *furtivus* DRAKE) in Ghana and in the Congo Republic is confirmed. Distribution and distinguishing notes are given about the *Cantacader* species mentioned in the paper. Notes on sexual dimorphism of *Cantacader* species are quoted; the most important secondary sexual character includes the length and width of the third antennal segment. The genus *Cyperobia* BERGR. (of New Zealand) is transferred from Phatnomini to Cantacaderini, as it has a markedly developed ventral stenocostal area.

This paper is based on material collected by the Hungarian Soil Zoological Expedition to the Brazzaville-Congo and by Dr. S. ENDRŐDY-YOUNGA in Ghana. (For details see: BALOGH, ENDRŐDY-YOUNGA & ZICSI, 1965; ENDRŐDY-YOUNGA, 1970.).

In the material studied 70 specimens of Cantacaderinae belonging to six species of two genera were ascertained including one newly described species. As our knowledge about the distribution of Cantacaderinae is still rather incomplete, the localities of the collected specimens are given below. Besides faunistic records, also distinguishing notes and notes on sexual dimorphism of *Cantacader* species are quoted.

Also a short note on *Cyperobia carectorum* BERGR. of New Zealand is included and the species is transferred from Phatnomini to Cantacaderini.

* *Dr. Josef M. Stusák*, Department of Animal Physiology and Zoology, University of Agriculture, 160 21 Prague 6 Suchdol, Czechoslovakia.

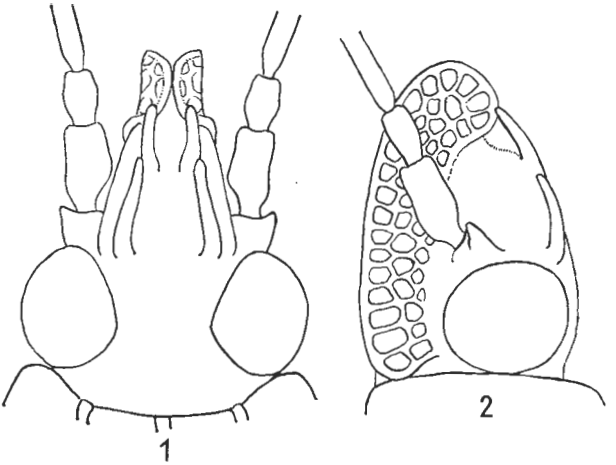


Fig. 1. *Cantacader angustecostatus* sp. n., head, dorsal view. – Fig. 2. *Cantacader angustecostatus* sp. n., head, lateral view

Acknowledgements

The author is very much indebted to the authorities of the Hungarian Natural History Museum for providing him access to the collections of the Entomological Department. He is especially indebted to Dr. Á. Soós and Dr. T. VÁSÁRHELYI for offering the privilege of studying the material of Cantacaderinae collected by the Hungarian expedition. Thanks are due also to Dr. G. SCHMITZ from the Musée Royal de l'Afrique Centrale, Tervuren (Belgium) for his kind assistance in arranging loans of SCHOUTEDEN's types of Cantacaderinae and for his help in the collection of some important and rare literature.

Cantacader angustecostatus sp. n.

Derivation of name: This new species is named after its very narrow costal area (angustus = narrow in Latin).

Macropterous form. Ochreous brown, similar to many other *Cantacader* species. Body shape narrowly prolonged, lateral margins of hemelytra almost parallel, body generally 3.3 – 3.5 times longer than wide.

Head ochreous brown, eyes blackish. Bucculae broadly rounded at their apices, short, reaching only very slightly beyond apex of anteclypeus, mostly triseriate, open in front or nearly touching anterodorsally (Figs. 1, 2). Spines of dorsal side of head adjacent and short, the first pair reaching about the level of apex of first antennal segment, the second pair about level of the middle of first antennal segment. Antenniferous tubercles short, smaller than second antennal segment, their outer corner pointed but not spine-like protruding. Synthlipsis 1.0 – 1.1 times longer than dorsal width of an eye. Antennae long and slender, yellowish ochreous, fourth segment dark brown. Third antennal segment as wide as anterior tibia and 1.72 – 1.88 times longer than median length of pronotum in male. (Female unknown, but third antennal segment probably shorter and more slender than in the male, as to be judged by analogy.) Rostrum reaches zygosternum IV (mostly at its middle).

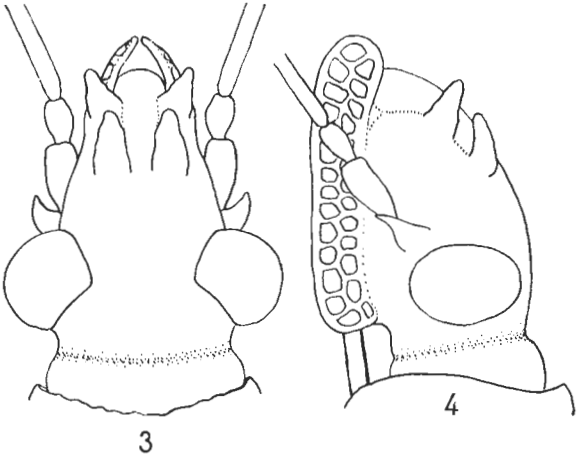


Fig. 3. *Cyperobia carectorum* BERGR., head, dorsal view. – Fig. 4. *Cyperobia carectorum* BERGR., head, lateral view

Pronotum approximately as long as wide (94 : 96), its shape similar to that of other *Cantacader* species, with five longitudinal carinae but only three of them strongly developed; outer carinae very short, only extending from the level of humeral angles to posterior pronotal margin. These carinae are much lower and thinner, not too expressively marked than median and lateral pronotal carinae. Pronotum anteriorly about as wide as the head, anterolateral angles of pronotum rounded. Paranotum with one row of areolae anteriorly, with two rows in its widest portion (at the level of the callosities) and with one row of very small, disappearing areolae behind the callosities and posteriorly. Paranotum broadly rounded (not angulate) at the level of the humeral angles. Pronotal disc rather convex and areolated (Fig. 5).

Hemelytra relatively narrow, with broadly arch-like, rounded apices. Stenocostal area uniseriate, erected up and somewhat reflexed inwards, so that the costal area is not visible from the dorsal aspect, except its distal portion. Costal area very narrow with one row (or sometimes with two incomplete rows) of small areolae proximally; the areolae growing smaller in caudal direction and gradually disappearing (or almost disappearing) in the median portion of the costal area; distal portion of costal area has two rows of small areolae (Figs. 8, 9). Subcostal area biseriate proximally and distally, and triseriate in its widest portion medially. Discoidal area with five (six) rows of areolae in its widest portion.

Legs yellowish ochreous, only the extreme apices of tarsi are a little darker. Lateral and ventral portions of thorax and abdomen are similar to those in the related species.

Measurements in mm (first value: holotype, values in parentheses: minimum and maximum of the type-series): length of body 4.25 (3.88 – 4.25), maximum width of body 1.30 (1.11 – 1.30), width of head 0.48 (0.47 – 0.53), length of antenna (♂♂) 2,13 (1,98 – 2.24) (I : II : III : IV = 0,14 [0.13 – 0.16]: 0.13 [0.11 – 0.14] 1.62 [1.53 – 1.70]: 0.24 [0.21 – 0.24], length of pronotum 0.94 (0.82 – 0.95), width of pronotum 0.96 (0.84 – 0.97).

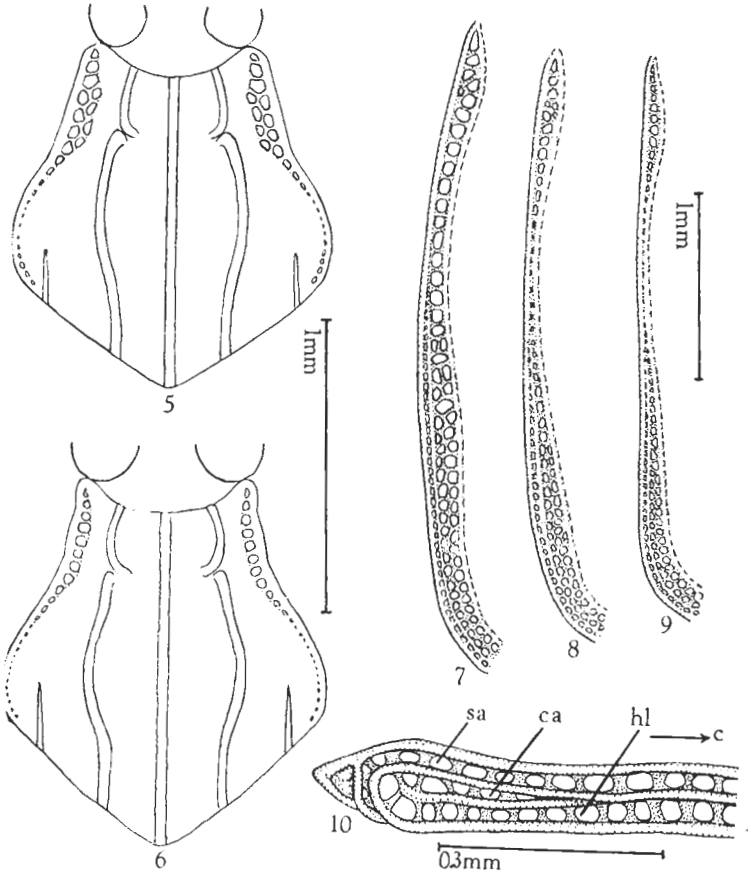


Fig. 5. *Cantacader angustecostatus* sp. n., pronotum with paranota and longitudinal carinae. – Fig. 6. *Cantacader gerardi* SCHOUT., pronotum with paranota and longitudinal carinae. – Figs. 7–9. Costal and stenocostal areas of hemelytra. The specimens were somewhat turned to the left to show the costal area clearly and also in horizontal position. Stenocostal areas visible only in distal halves as they are vertically turned up in their anterior halves. 7: *Cantacader allaeri* SCHOUT., male. 8, 9: *Cantacader angustecostatus* sp. n., males, two extreme cases. – Fig. 10. *Cyperobia carectorum* BERGR., lateral view on basal portion of left hemelytron; *sa:* stenocostal area, *ca:* costal area, *hl:* hypocostal lamina, *c:* caudal direction

Holotype ♂: Ghana, Ashanti region, Kumasi, N 6° 43′ – W 1°36′, 293 m, No. 8, taken at light, 23 – 29. 5. 1965, leg. S. ENDRŐDY-YOUNGA.

6 paratypes: The same locality and data (2 ♂♂). Ghana, Ashanti region, Kwadaso, N 6[42' – W 1[39', 259 m, black light, 5.5.1969 (1 ♂). République du Congo (Congo-Brazzaville: Lefinie Reservation, bungalow near Mpo, Nr. 604, singled on savannah, 8. 1. 1964, Soil Zool. Exp., leg. BALOGH & ZICSI (1 ♂). Mt. Fouari Reservation near Gabon, Nr. 456, by lamplight, 12. 12. 1963 (1 ♂). Plato Bateke, Oban, by lamplight on savannah, 5. 1. 1964 (1 ♂). If not mentioned otherwise, all materials were collected by S. ENDRŐDY-YOUNGA. – Holotype and paratypes deposited in the Hungarian Natural History Museum, Budapest.

Distinguishing notes: The new species belongs to the group of *Cantacader* species which have five longitudinal carinae on the pronotum and of which the outer pronotal carinae are very short. It is, therefore, related to *C. basilewskyi* SCHOUT., *C. gerardi* SCHOUT. and *C. allaeri* SCHOUT., and is similar to *C. basilewskyi* by its very narrow costal area which is almost rib-like (with tiny disappearing areolae) medially. It considerably differs, however, in having the third antennal segment much longer (1.72 – 1.88 times longer than pronotal length in the male of the new species, only 1.2 times in the male of *C. basilewskyi*), in its narrower synthlipsis (1.4 times longer than eye in male of *C. basilewskyi*) and in general appearance, since *C. basilewskyi* is a dark brown species with a blackish head. *C. angustecostatus* sp. n. differs from *C. gerardi* especially in the shape of the pronotum, which is narrower anteriorly than the head and with very narrow uniseriate paranota in *C. gerardi* (Figs. 5, 6), and in having very narrow costal area. The costal medially in *C. gerardi* as well as in *C. allaeri* (Fig. 7). The new species differs from *C. allaeri* in having its costal area very narrow and in having a longer rostrum usually reaching the middle of zygosternum IV in the new species, while in *C. allaeri* the rostrum reaches the middle of zygosternum III. The outer pronotal carinae are very short and slender; sometimes these are not too marked in the new species, so that it may resemble *C. hulstaerti* SCHOUT. in which the pronotum is only tricarinate since the outer carinae are nearly or quite absent. The new species differs, however, from that species also in the narrow costal area, as the costal area is wider, mostly biseriate medially in *C. hulstaerti*.

Cantacader hulstaerti SCHOUTEDEN, 1965

In the material studied there were 17 specimens (♂♂) with the following data:

Ghana: Northern region, Banda-Nkwanta, 122 m, N 8° 22′ – W 2°09′, light trap, leg. S. ENDRŐDY-YOUNGA: Nr. 20, 1 – 7. 7. 1965, 1 ♂; No. 46, 20 – 24. 7. 1965, 1 ♂; No. 56, 10 – 13. 8. 1965, 1 ♂; No. 58, 19 – 22. 8. 1965, 2 ♂♂; No. 73. 13 – 17. 9. 1965, 1 ♂; No. 80, 18 – 20. 9. 1965, 1 ♂; No. 82, 24 – 26. 9. 1965, 5 ♂♂; No. 83, 27 – 29. 9. 1965, 3 ♂♂.

République du Congo (Congo-Brazzaville): Lefinie Reservation, bungalow near Mpo, No. 604, 8. 1. 1964, singled on savannah, Soil Zool. Exp., leg. BALOGH & ZICSI, 1 ♂. Kindamba, Méya, settlement, 7. 11. 1963, by lamplight, Soil Zool. Exp., leg. S. ENDRŐDY-YOUNGA, 1 ♂.

The species was described from Zaire (Bamania, Equateur) and is newly recorded from the République du Congo and Ghana.

This species is clearly distinguishable by having only three well-developed longitudinal carinae on the pronotum running from the anterior to the posterior pronotal margin. The outer carinae are either quite absent or only very indistinctly indicated at the posterior pronotal margin, and the costal area is biseriate medially.

Cantacader clairi SCHOUTEDEN, 1965

Five (4 ♂♂, 1 ♀) specimens were ascertained in the material studied:

Ghana: Upper region, Tumu, N 10° 08′, No. 516, 16. 1. 1972, soil trap, 1 ♀. Northern region, Banda-Nkwanta, 122 m, N 8° 22′ – W 2° 09′, No. 82, 24 – 26. 9. 1965, light trap, 2 ♂♂; No. 80, 18 – 20. 9. 1965, 1 ♂, leg. S. ENDRŐDY-YOUNGA.

République du Congo: Lefinie Reservation, bungalow near Mpo, No. 590, 6. 1. 1964, by lamplight, leg. BALOGH & ZICSI, 1 ♂.

This species was described and known from Zaire (Lubudi, Katanga) and is newly recorded from the République du Congo and Ghana.

It is similar to *C. divisus* BERGROTH but differs from that species especially in a wider costal area which is triseriate medially in *C. clairi*.

Cantacader afzelii STAL, 1873

In the Hungarian material there were 12 specimens (5 ♂♂, 7 ♀♀) from the following localities:

Ghana: Ashanti region, Kwadaso, 259 m, N 6° 42′ – W 1°39′, No. 341, mixed light, 28. 4. 1969, 1 ♀. Kumasi, 330 m, N 6° 43′ – W 1° 36′, No. 284, black light, 27. 10. 1967, 1 ♀. Kumasi, 293 m, No. 290, light trap, 10. 12. 1967, 1 ♂, 1 ♀; No. 230, 2. 7. 1967, 1 ♂. Northern region, Banda-Nkwanta, 122 m, N 8° 22′ – W 2° 09′, No. 80, light trap, 18 – 20. 9. 1965, 1 ♀.

République du Congo: Sibiti IRHO, oil-palm plantation, No. 224, 23, 11. 1963, sifted fallen oil-palm fruits, 1 ♀. Sibiti IRHO park, No. 287, 28. 11. 1963, by lamplight, 1 ♀. Brazzaville ORSTOM park, No. 563, 30. 12. 1963, light trap, 1 ♂; No. 220. 22. 11. 1963, leg. BALOGH & ZICSI, 1 ♀; No. 32, 25. 10. 1963, 1 ♂. Mt. Fouari reservation near Gabon, No. 462, 13. 12. 1963, by lamplight, 1 ♂. If not mentioned otherwise, all specimens were collected by S. ENDRŐDY-YOUNGA.

The species was described from Sierra Leone and later reported from Guinea, Ivory Coast, Liberia, Ghana, Ethiopia, Somalia, Kenya, Zaire, Angola and Mascarene Islands (Mauritius). It has been newly reported from the République du Congo.

It is one of the most common Ethiopian *Cantacader* species and can be easily recognized by the rounded anterolateral angles of pronotum, five-carinated pronotum with long outer protonal carinae and by a narrow uniseriate costal area.

Cantacader tenuipes STAL, 1865

In the material studied there were 26 specimens (22 ♂♂ and 4 ♀♀) to be found, labelled as follows:

Ghana: Ashanti region, Kumasi, 330 m, N 6° 43′ – W 1°36′, at light, No. 13, 18 – 20. 6. 1965, 1 ♂; No. 14, 21 – 23. 6. 1965, 1 ♀; No. 206. 1 – 7. 3. 1967, 1 ♂; No. 225, 12. 6. 1967, 1 ♂; No. 230, 2. 7. 1967, 1 ♂; No. 290, 10. 12. 1967, 2 ♂♂. Kwadaso, 259 m, N 6° 55′ – W1° 39′, No. 358, 22. 5. 1969, light trap, 1 ♂. Brong-Ahafo region, Bui camp, 130 m, N 8° 17′ – W 2° 15′ light trap, No. 87, 27. 10. 1965, 1 ♂.

République du Congo: Soil Zool. Exp., Brazzaville, ORSTOM park, light trap, No. 524, 26. 12. 1963, 1 ♀; No. 220, 22. 11. 1963, leg. BALOGH & ZICSI, 4 ♂♂; No. 506, 24. 12. 1963, 5 ♂♂; No. 538, 28. 12. 1963, 2 ♂♂, 1 ♀; Mt. Fouari reservation near Gabon, No. 456, 12. 12. 1963, 1 ♂, 1♀. Loudima SAGRO park, No. 453, 11. 12. 1963, light trap, 1 ♂; No. 431, 10. 12. 1963, 1 ♂. If not mentioned otherwise, all materials were collected by S. ENDRŐDY-YOUNGA.

The species was described from Sierra Leone, and later reported from the Aden Protectorate, Somalia, Guinea, Ghana, Zaire, Angola, Kenya, and the variety *furtivus* DRAKE also from the République du Congo.

It seems to be the most common one of the Ethiopian *Cantacader* species, characterized by sharply pointed anterolateral angles of the pronotum, very long and considerably anteriorly produced apically pointed bucculae, very long spines of the head, the anterior pair of which reaches the level of the anterior apex of the bucculae and by the apex of hemelytron being angularly curved.

The variety *furtivus* DRAKE, previously known from Zaire and the République du Congo, is characterized by having its sutural area mostly dark brown

including the median portions of the discoidal, subcostal and costal areas; the variety seems to be only an extremely dark form of the species, as in the other specimens of the material studied the dark colouring is less than in the holotype of this variety and disappears in different ways in various specimens.

Phatnoma maynei SCHOUTEDEN, 1916

Three specimens (2 ♂♂ and 1 ♀) of this interestring species were ascertained in the material studied:

République du Congo: Brazzaville, ORSTOM park, Soil Zool. Exp. No. 698, 16. 1. 1964, beaten, leg. BALOGH & ZICSI, 2 ♂♂. Lefinie reservation, Mbéokala forest, Soil Zool. Exp. No. 639, 10. 1. 1964, beaten in forest, leg. BALOGH & ZICSI, 1 ♀.

The species was described from Zaire (Congo da Lemba) and has been newly reported from the République du Congo.

The studied specimens fully agree with SCHOUTEDEN's holotype.

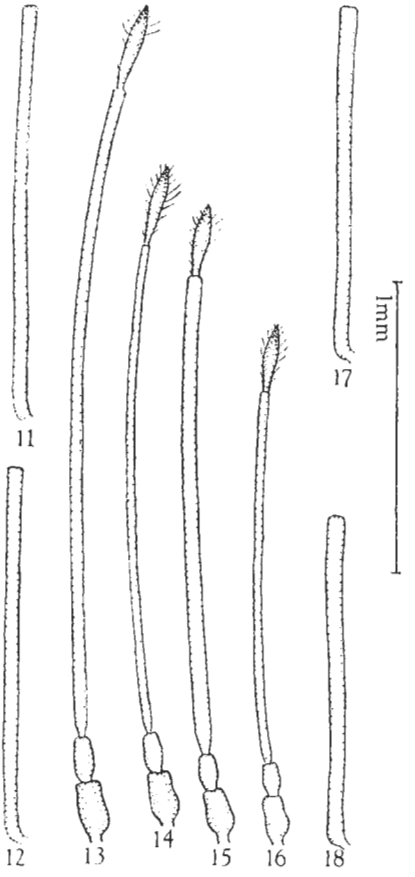
On sexual dimorphism

The species of *Cantacader* (as well as of Cantacaderinae) were described in rather different ways (not uniformly), so that their identification relying on the original descriptions is very difficult, sometimes even impossible. In many original descriptions the sex of the holotypes or that of the specimens underlying the description or figure were not mentioned although the sex of a specimen seems to be very important, since some of the distinguisting characters correspond to sex and are, therefore, secondary sexual characters. After studying a rich collection of the Ethiopian *Cantacader* species (kindly lent by the Musée Royal de l'Afrique Centrale, Tervuren and the Hungarian Natural History Museum) it has been possible to record some notes on the distinctive characters depending on sex of *Cantacader* specimens. Probably, that the notes can also be applied to other genera of Cantacaderinae.

Although the differences between males and females of Cantacaderinae are of the same general qualitative character as in the majority of Tingidae, the secondary sexual characters are much more developed in Cantacaderinae than in Tinginae. The most important sexual differences in the *Cantacader* species include especially the shape and size of antennae, the size of eyes and synthlipsis and the width of the subcostal area.

There is considerable dimorphism in the length and width of the third antennal segment. The length of the segment can be used not only as a distinctive character of sex in specimens of the same species but also as one in different species in specimens of the same sex. It can be assumed in general in *Cantacader* species that the third antennal segment is at all times much longer and wider in males than in females of the same species, being approximately as wide as the anterior tibia in the former and much thinner than the anterior tibia in the latter (Figs. 11 – 18). There exist, of course, special situations in different species.

A further instance of sexual dimorphism is to be observed in the size of eyes and synthlipsis just as in many groups of Heteroptera. The dorsal width of an eye and the width of synthlipsis can be applied as distinguishing characters of



Figs. 11 – 18. Anterior tibiae and sexual dimorphism in right antenna of some *Cantacader* species. 11: *C. tenuipes* STAL, tibia of male. 12: *C. tenuipes* STAL, tibia of female. 13: *C. tenuipes* STAL, antenna of male. 14: *C. tenuipes* STAL, antenna of female. 15: *C. afzelii* STAL, antenna of male. 16: *C. afzelii* STAL, antenna of female. 17: *C. afzelii* STAL, tibia of male. 18: *C. afzelii* STAL, tibia of female

species only in relation to the sex of the examined specimens as there are differences between males and females, expressed differently in different *Cantacader* species.

The shape of the body is usually (but not always) broader in females than in males, especially the subcostal area; also the discoidal and distal portion of the costal area may be somewhat dilated, since they are, as a rule, enlarged by one incomplete row of areolae.

Therefore, when studying and identifying Cantacaderinae, sex needs to be taken into consideration.

The *Cantacader* species were collected predominantly at light, and it is interesting that males could be collected in much greater numbers than females. From the studied material (55 ♂♂: 12 ♀♀) it seems, that males are more active and can more intensively fly to light traps than females.

Cyperobia carectorum BERGROTH, 1927

I had the opportunity to examine one specimen of Cantacaderinae in the collections of the Hungarian Natural History Museum; it was identified as *Cyperobia carectorum* BERGR. (♂) by W. E. CHINA in 1929, labelled New Zealand, Karori, 8. 3. 1924. This specimen considerably differs from the original description of *Carldrakeana socia* (DRAKE & RUHOFF, 1961) and also from the figure given by the authors not only in its general appearance and much slender stature, but also in some detailed characters. It resembles, however, the figure as given by DRAKE & DAVIS (1960) and Fig. 18. presented by WOODWARD (1961). FROESCHNER (1968), however, wrote that the figure of *Cyperobia carectorum* given by DRAKE & DAVIS (1960) was in fact *Carldrakeana socia* and also WOODWARD's Fig. 19. represents *Carldrakeana socia*. I am unable to comment on this point, as I did not examine the types of *Carldrakeana* FROESCH., but there is no doubt that the specimen identified as *Cyperobia carectorum* by CHINA differs from *Carldrakeana socia*. Neither is there any reason to hesitate as to the correct identification of the specimen in the Hungarian Museum.

FROESCHNER (1968) transferred the genus *Stenocader* DRAKE & HAMBLETON from Phatnomini to Cantacaderini, as it had the stenocostal area very strongly developed, but only ventrally. In the specimen of *Cyperobia carectorum*, which is at hand the ventral developed of the stenocostal area is clearly evident, in the same way as in *Stenocader* (Fig. 10). Therefore, the genus *Cyperobia* BERGROTH needs to be transferred from Phatnomini to the tribe Cantacaderini. It seems that *Cyperobia* is related to *Stenocader* not only by the ventral development of its stenocostal area but also by the general character of head (Figs. 3, 4).

Thus, *Cyperobia* differs from *Carldrakeana*, among others, in the presence of a ventral stenocostal area.

REFERENCES

1. BALOGH, J., ENDRŐDY-YOUNGA, S. & ZICSI, A. (1965): *The scientific results of the Hungarian soil-zoological expedition to the Brazzaville-Congo. A report on the collectings.* – Fol. Entomol. Hung., 18: 213–280.
2. DRAKE, C. J. & DAVIS, N. T. (1960): *The morphology, phylogeny, and higher classification of the family Tingidae, including the description of a new genus and species of the subfamily Vianaidinae (Hemiptera: Heteroptera).* – Ent. Amer., 5: 1–100.
3. DRAKE, C. J. & RUHOFF, F. A. (1961): *New genera and new species of lacebugs from the Eastern Hemisphere (Hemiptera: Tingidae).* – Proc. U. S. Nat. Mus., 113: 125–183.
4. DRAKE, C. J. & RUHOFF, F. A. (1965): *Lecebugs of the world: A catalogue (Hemiptera: Tingidae)* – U. S. Nat. Mus. Bull., 243: 1–634.
5. ENDRŐDY-YOUNGA, S. (1970): *Entomological Explorations in Ghana by Dr. S. Endrődy-Younga. 1. A Diary of Entomological Collection in Ghana 1965–1969.* – Fol. Entomol. Hung., 23: 5–91.
6. FROESCHNER, R. C. (1968): *Notes on the systematics and morphology of the lacebug subfamily Cantacaderinae (Hemiptera: Tingidae).* – Proc. Ent. Soc. Wash., 70: 245–254.
7. SCHOUTEDEN, H. (1916): *Tingides du Congo Belge.* – Rev. Zool. Afr., 4: 288–297.
8. SCHOUTEDEN, H. (1955): *Tingides nouveaux des collections du Musée Royal du Congo Belge.* – Rev. Zool. Bot. Afr., 52: 162–168.
9. SCHUOTEDEN, H. (1965): *Tingides africains nouveaux du genre Cantacader Amyot et Serville.* – Rev. Zool. Bot. Afr., 72: 168–172.
10. WOODWARD, T. E. (1961): *The Heteroptera of New Zealand. Part III – Coreidae, Berytidae, Tingidae, Cimicidae.* – Trans. Roy. Ent. S. New Zealand, 1: 145–158.

Oniscoiden-, Diplopoden- und Chilopoden-Gemeinschaften im Untersuchungsgebiet „Sikfőkút-Projekt" (Ungarn)

Von

E. H. Székelyhidy und I. Loksa*

Abstract. To establish the quantitative proportions of populations the authors used 25×25 cm (= 1/16 m²/ litter and soil samples. In four occasions the authors examined besides the litter and the loose humus horizon the soil beneath it down to 20 cm depth. The examinations were carried out for two years. For qualitative investigations of species 10 ethylene glycol soil traps were functioned continuously.

The authors established that the population of Oniscinea comprised 3, that of Diplopoda 9 and that of Chilopoda 14 species. In litter consumption the group of Oniscinea play an inferior role, while the importance of Diplopoda is great. On the basis of indirect calculations they consume 5–6% of the annual litter. The vertical movement of Diplopoda in the sampling area is negligible, while the same of Diplopoda, especially those of Geophilomorphae is significant. With conventional sampling the species composition of Geophilomorphae may be established but their quantitative proportions might only be guessed.

The greatest dominance is displayed among the Diplopoda by *Chromatoiulus projectus:* among the lithobiomorph Chilopoda the species of *Lithobius mutabilis* and *L. muticus:* while tamong the geophilomorph Chilopoda the species of *Schendyla nemorensis* and *Clinopodes flavidus.*

The evaluation of the material is based on the data presented in 12 tables.

Im Rahmen der in Ungarn laufenden Ökosystem-Forschungen sind zahlreiche Bekanntmachungen über die in Sikfőkút durchgeführten Untersuchungen bisher veröffentlicht worden (Jakucs, 1973; Papp, 1972; Papp & Tóth, 1973 etc.). Die vorliegende Arbeit liefert den ersten Beitrag über die qualitativen und quantitativen Verhältnisse der Oniscoiden-, Diplopoden- und Chilopoden-Gemeinschaften dieses Waldbestandes.

Ohne auf die ausführlichen Vegetationsverhältnisse des Untersuchungsgebietes an dieser Stelle eingehen zu müssen, diese sind den weiter oben angeführten Arbeiten zu entnehmen, sei bloss erwähnt, dass es sich um einen etwas über 60-jährigen Traubeneichen-(Zerreichen-)Bestand (Quercetum petraeae–

* *Frau Haláisz, Edit Székelyhidy* und *Dr. Imre Loksa*, ELTE Állatrendszertani és Ökológiai Tanszék (Lehrstuhl für Tiersystematik und Ökologie der Eötvös-Loránd-Universität), 1088 Budapest VIII., Puskin-u. 3.

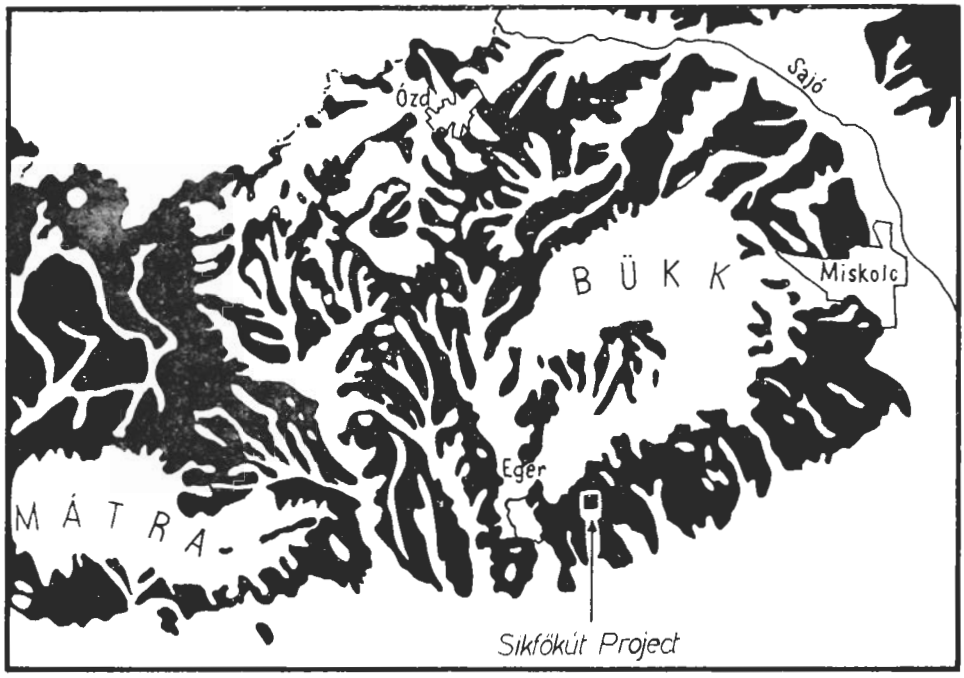


Abb. 1. Geographische Lage des Untersuchungsgebietes „Sikfőkút-Projekt". Schwarz angedeutet ist die zonale Verbreitung der Traubeneichen-(Zerreichen-)Bestände (nach JAKUCS)

cerris) handelt, deren geographische Lage auf Abb. 1 veranschaulicht wird. Den Habitus in Spätherbst und Frühjahr des Waldbestandes führen wir auf Abb. 2 u. 3 an. Die Untersuchungen wurden in dem strauchartigen, aus dem Gesichtspunkt der Krautschicht in dem Subnudum übergehenden Fazies durchgeführt.

Die Aufsammlungen wurden im Jahre 1974 und 1975 durchgeführt. Im ersten Jahr wurden monatliche Proben in der Vegetationsperiode (vom März bis Oktober) genommen, im zweiten Jahr im April, Juli, September und November.

Zur Bestimmung der qalitativen und quantitativen Verhältnisse wurden folgende Sammelmethoden angewandt. Die quantitativen Proben wurden mit Hilfe eines 25×25 cm flächengrossen Bodenausstechers entnommen, wobei nur die Streu und obere Humusschicht berücksichtig wurde. Die Proben wurden in Insektensieben von 1 cm² Maschenweite ausgesiebt, die Tiere an Ort und Stelle ausgelesen. 10 Parallelproben bildeten eine Aufnahme.

Um die vertikale Migration der untersuchten Tiergruppen verfolgen zu können, wurden bei 6 Gelegenheiten auch tiefere Proben genommen. Diese wurden mit dem Bodenausstecher nach ZICSI (1957) bis 20 cm Tiefe entnommen. Diese Proben wurden mit der Hand, ohne Sieben, ausgelesen.

Zur Ergänzung der quantitativen Proben wurden 10 Ethylenglykol-Barberfallen ausgestellt, die bei den quantitativen Probeaufnahmen geleert wurden.

Ergebnisse der quantitativen Untersuchungen

Ausser der Gestaltung der zönologischen Charakteristiken bei den einzelnen Tiergruppen, befassen wir uns ausführlicher nur mit den dominanten Arten. Das Primär-Material und die Berechnungen des gesamten Arten-Bestandes sind den Tabellen I – XII. zu entnehmen.

A. Landasseln (Oniscinea) und Doppelfüssler (Diplopoda).

Während den quantitativen Aufnahmen konnten folgende Arten nachgewiesen werden:

Oniscinea: *Porcellium collicola* VERH.
Protracheoniscus amoenus DOLFF.
Orthometopon planum B. L.
Diplopoda: *Heteroporatia bosniense* VERH.
Polydesmus complanatus L.
Chromatoiulus projectus dioritanus VERH.
Leptoiulus proximus NEMEC.
Cylindroiulus boleti KOCH.
Polyzonium germanicum BRANDT.

In dieser Biozönose ist die Bedeutung der Asseln untergeordnet. Ihre maximale Individuendichte betrug 12,8/m², nur *Porcellium collicola* erreicht in der zweiten Hälfte des Jahres, während ihrer Vermehrungsperiode, höhere Dominanz-Werte.

Die Diplopoden hingegen spielen in diesem Bestand eine bedeutende Rolle. Wie aus den Aufnahmen zu ersehen, halten sie sich ausschliesslich in der Streu- und Humusschicht auf, nur in der Winterperiode ziehen sie sich einige cm tief in den Boden zurück.

Es wurde die Gesamtindividuendichte (Abb. 4) und Produktion (Abb. 5) der Asseln und Diplopoden gemeinsam während der einzelnen Aufnahmen veranschaulicht. In Tabelle 1 sind die beiden Werte zusammengefasst.

Tabelle 1. Gesamtabundanz- und Produktionswerte der Asseln und Diplopoden

1974

Monat	III	IV	V	VI	VII	VIII	IX	X
A/m^e	24,0	32,0	35,2	19,2	44,8	34,0	52,8	51,2
P/m^e/mg	6107	7418	8550	5324	5739	5870	8448	8805

1975

Monat	IV	VII	IX	X
A/m^e	30,4	41,6	44,8	40,0
P/m^e/mg	5328	5774	6954	7214

Tabelle 2. Individuendichte von Chromatoiulus projectuss (A/m^2), Dominanz innerhalb der Gruppe (D_2), Produktion (P/m^2), Trockengewicht pro mg und prozentueller Gewichtsanteil innerhalb der Gruppe (G %)

1974

Monat	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
A/m^2	17,6	20,8	24,0	16,0	20,8	16,0	30,4	32,0
D_2	73,33	65,00	68,18	83,33	46,43	52,63	57,58	62,50
P/n		7056	8152	5254	5226	5541	7701	8211
$G\%_{02}$	96,02	95,13	95,34	98,68	91,05	94,39	91,16	93,26

1975

Monat	IV.	VII.	IX.	XI.
A/m^2	19,2	25,6	24,4	20,8
D_2	63,13	61,54	53,57	52,00
P/mf/mg	4874	5352	6011	6598
$G\%_{02}$	91,47	92,68	86,57	91,46

Bei sämtlichen Untersuchungen erwiesen sich die Werte von *Chromatoiulus projectus* am höchsten. Da die Entwicklung dieser Art 2–3 Jahre dauert, konnten stets adulte und juvenile Tiere angetroffen werden. Die Vermehrung ergolft im Juni-Juli, durch die geschilderte Aufnahme-Methode liessen sich juvenile Tiere erst nach zwei-drei Monaten nachweisen. Wie aus Tabelle 2 ersichtlich, sind die Individuen – und Gewichtswerte dieser Art stets hoch.

Erwähnenswert sind noch Arten *(Heteroporatia bosniense* und *Polyzonium germanicum)*, obwohl sie nicht mit hoher Individuenzahl vertreten waren. *H. bosniense* deswegen, da dies die einzige Diplopoden-Art ist, deren vollkommene Entwicklung sich innerhalb eines halben Jahres abspielt. Bei einer eventuellen Gradation muss sie als bedeutender Streukonsument in Betracht gezogen werden. Die Ernährungsweise von *P. germanicum* ist noch nicht geklärt, sie wurde in der Humusschicht und in der untersten Streuschicht angetroffen. Durch die besondere Ausbildung ihrer Mundwerkzeuge kann sie nur weiche Substanzen aufnahmen.

Aufgrund der Untersuchungen des Botanischen Institutes der L. Kossuth Universität Debrecen, betrug die Gesamtmenge des Fallaubes im Jahre 1974 von März bis Dezember 429,6783 g/m². Aufgrund der Untersuchungen von GERE (1956), die zwar in einem anderen Bestand durchgeführt wurden, verzehren die Diplopoden 5–6% der Gesamtstreu pro Jahr. Bezüglich der Untersuchungsperiode würde dies in unserem Falle 21,4840 g ausmachen. Die angeführten Angaben sind nur Orientierungswerte, genauere Untersuchungen sind in Gang gesetzt worden.

Abb. 2. Aspekt im November

Abb. 3. Aspekt im Mai

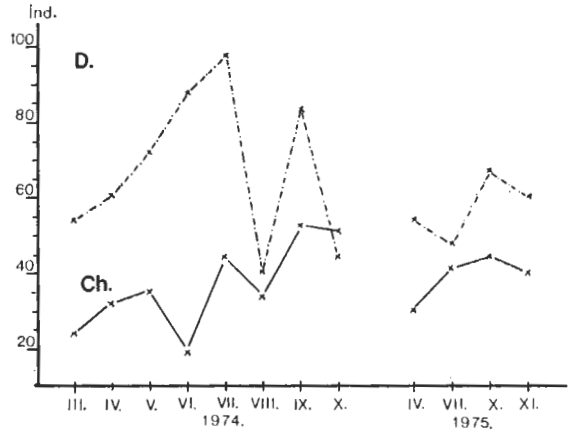


Abb. 4. Veränderungen der Individuenzahldichte (A/m²) bei den Oniscoideen, Diplopoden *(D)* und Chilopoden *(Ch)*

B) Hundertfüssler (Chilopoda)

In den quantitativen Proben konnten folgende Arten nachgewiesen werden:

Lithobiomorpha:	*Litobius forficatus* L.
	Litobius mutabilis Koch
	Lithobius muticus Koch
	Lithobius agilis Bröl.
	Lithobius pusillus Latz.
	Monotarsobius aeruginosus Koch
Scolopendromorpha:	*Cryptops hortensis* Bröl.
	Cryptops anomalans Newp.
Geophilomorpha:	*Schendyla nemorensis* Bröl.
	Brachyschendyla montana Att.
	Scolioplanes transsylvanicus Verh.
	Henia illyrica Mein.
	Geophilus proximus Verh.
	Clinopodes flavidus Koch.

Diese, verschiedenen Gruppen angehörenden Arten unterschieden sich auch in der Lebensweise voneinander. Die Lithobiomorphen und Scolopendromorphen bewegen sich äusserst rasch und ernähren sich räuberisch, hauptsächlich von verschiedenen Insekten, die kleineren Formen vorwieglich von Collembolen der Streuschicht. Die Geophilomorphen hingegen leben in verschiedener Tiefe des Bodens und ernähren sich von kleinen Lumbriciden, Enchytraeiden und Fliegenlarven (Brauns, 1968). In Bodenrissen oder Regenwurm-Gängen, wie auch in Wurzel-Gängen können sie auch in tiefere Schichten des Bodens eindringen. In einem Hainbuchen-Eichenbestand des Cserhát-Gebirges, am Fusse des Naszály-Berges, wo grosskörperige Lumbriciden-Arten *(L. polyphemus, D. platyura platyura* und *D. p. depressa)* weit verbreitet sind, konnten sie auch bis 1,8 m Tiefe nachgewiesen werden.

In Tabelle 3 fassen wir die quantitativen Verhältnisse der in der Streu und im Boden bis 20 cm Tiefe angetroffenen und auf 1 m² berechneten Werte der Individuendichte an.

Tabelle 3. Individuendichte (A/m²) der Chilopoden-Gruppen in der Streuschicht bzw. im Boden (0 – 20 cm)

	1974			1975		
	Monat			Monat		
	VII.	X.	IV.	VII.	IX.	XI.
Lithobiomorphen in der Streuschicht	70,4	32,0	30,4	41,6	41,6	48,0
Scolopendromorphen in der Streuschicht	4,8	3,2	1,6	–	6,4	4,8
Geophylomorphen in der Streuschicht	22,4	9,6	22,4	6,4	19,2	8,0
Scolopendromorphen im Boden	–	–	–	–	1,6	–
Geophilomorphen im Boden	96,0	64,0	54,4	102,4	123,2	108,8

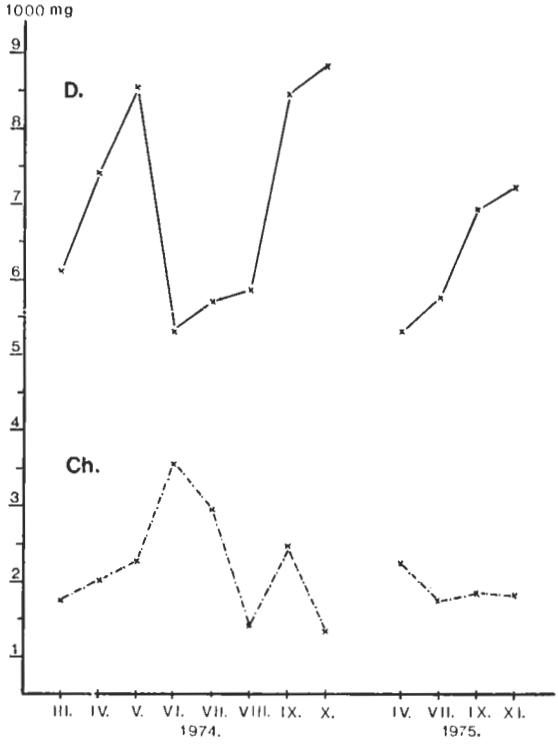


Abb. 5. Veränderungen der Produktionswerte (Zoomasse: P/m²) bei den Oniscoideen, Diplopoden *(D)* und Chilopoden *(Ch)*

Tabelle 4. Werte der Charakteristika von Lithobius mutabilis in den verschiedenen Monaten

1974

	III.	IV.	V.	VI.	VII	VIII.	IX.	X.
A/m²	19,2	17,6	24,0	25,6	40,0	22,4	27,2	16,0
D	35,29	28,95	33,33	29,09	40,98	56,00	32,69	35,71
P/m²/mg	606	536	664	858	1122	818	838	576
G/%	33,84	29,10	29,14	24,07	33,67	43,71	33,55	42,30

1975

	IV.	VII.	IX.	XI.
A/m²	16,0	28,8	20,8	27,2
D	29,42	60,00	30,96	44,74
P/m² (mg)	573	712	459	547
G/%	25,44	39,77	24,68	29,51

Das beträchtige Ansteigen der Abundanzwerte bei den Geophilomorphen im Jahre 1975 lässt sich mit den höheren Niederschlagsmengen erklären. (Nach Angaben des Meteorologischen Lehrstuhles der L. Kossuth Universität, Debrecen betrug die Gesamtmenge der Niederschläge im Jahre 1974 808 mm, 1975 675 mm).

Bei drei Aufnahmen wurde der Bodenausstich in zwei Schichten (0–10 cm und 10–20 cm) gesondert nach Tieren untersucht. Auf Abb. 6 ist die Gesamtzahl der Chilopoden entsprechend der Verteilung in der Streuschicht und in den beiden Schichten des Bodens veranschaulicht. Die meisten Tiere wurden in der oberen Bodenschicht angetroffen, dort wo auch die meisten Gänge und Hohlräume anzutreffen sind. Auf Abb. 6 wurden die Verhältnisse des Monates September 1975 veranschaulicht, ähnlich gestaltete sich die Verteilung der Tiere auch in den Monaten Juli und November.

Unter den Lithobiomorphen war *Lithobius mutabilis* während der Versuchszeit die häufigste Art. Die Werte der Charakteristika werden in Tabelle 4 zusammengefasst. Die Entwicklung der Art ist langfristig, deswegen können ständig junge und adulte Individuen angetroffen werden. Im Frühjahr ist ihre Individuenzahl niedrig, dies lässt sich durch das Eingehen der Tiere im Winter erklären. Jungtiere können am häufigsten im Juli nachgewiesen werden. Übrigens ist dies für sämtliche Lithobiiden kennzeichnend.

Hohe Abundanzwerte konnten noch bei *Lithobius muticus* festgestellt werden, diese erreichen bei einigen Aufnahmen die von *L. mutabilis*. Ebenfalls zahlreich war noch die kleinkörperige Art *Monotarsobius aeruginosus*, während die übrigen drei *Lithobius*-Arten als akzessorische Elemente betrachtet werden können.

Von den Scolopendromorphen konnten nur zwei Arten im untersuchten Waldbestand nachgewiesen werden, u. zw. die kleinkörperige *Cryptops hortensis*, die auch eine Individuendichte von 6,4 pro m² erreichte und die grosskörperige Art *Cryptops anomalans*, die nur ganz vereinzelt vorkam.

Tabelle 5. Werte der Charakteristika von C. flavidus und S. nemorensis in den verschiednen Monaten

	1974			1975		
	VII.	X.	IV.	VII.	IX.	XI.
	Clinopodes flavidus					
A/m²	17,60	12,80	20,80	27,20	25,60	28,80
D	18,33	20,00	38,24	26,56	20,51	26,47
G %	51 43	52,43	78,96	67,78	54,06	59,85
P/m²	1123	1363	2378	2448	3155	3238
	Schendyla nemorensis					
A/m²	67,20	38,40	25,60	64,00	60,80	56,00
D	70,00	60,00	47,06	62,50	48,72	51,47
G %	20,66	11,38	6,75	11,38	7,68	8,07
P/m²	451	296	203	411	448	437

Von den 6 im Untersuchungsgebiet nachgewiesenen Geophilomorpha-Arten, sind nur zwei von grösserer Bedeutung. Die kleine *Schendyla nemorensis* besitzt eine äusserst hohe Individuendichte (25,6 – 67,2 pro m²), ihr Gewichtsanteil ist prozentuell niedrig, da es sich um eine kleinkörperige Art handelt. Die grosse *Clinopodes flavidus* (die auch eine Länge von 55 mm erreicht) wies eine Individuendichte von 12,8 – 28,8) m² in 20 cm Tiefe des Bodens auf und erreichte im April 1975 einen Gewichtsanteil von 78,96%. Aus den angeführten Angaben lässt sich die Bedeutung dieser räuberisch lebenden Art ermessen. Sie wurde übrigens bei feuchtem Wetter oft auch in der Streuschicht, angetroffen.

In Tabelle 5 fassen wir die Charakteristika dieser beiden Arten in der Bodenschicht von 0 – 20 cm zusammen. Die Angaben beziehen sich auf 1 m² bis zu 20 cm Tiefe.

Höhere Werte zeigt noch *Henia illyrica*, die ebenfalls eine grosskörperige Art ist (35 mm). Zwischen den drei angeführten Arten besteht unserer Meinung nach keine Nahrungskonkurrenz, höchstens bei den Jungtieren. Die adulten *C. flavidus* ernähren sich hauptsächlich von kleinen Regenwürmern, bezüglich *H. illyrica* stehen uns keine genauen Beobachtungen zur Verfügung, doch ist es anzunehmen, dass sie sich in erster Linie von kleineren Insektenlarven ernährt.

Ergebnisse der qualitativen Untersuchungen

Die Artenzusammensetzung des untersuchten Waldbestandes wurde durch die monatlich geleerten 10 Bodenfallen ergänzt. Es ist eine bekannte Tatsache, dass sich aus den Ergebnissen der Bodenfallen keine quantitativen Ergebnisse erzielen lassen. Die Funktion der Ethylenglykol-Fallen ist im Grunde genommen auch heute noch nicht genau bekannt. Im allgemeinen wird angenommen, dass die Tiere beim Ortswechsel in die Fallen geraten, doch kann auch der süssliche Geruch der Flüssigkeit eine Anziehungskraft besitzen. Wenn Kleinsäugetiere in die Falle geraten, so werden Silphiden und Staphyliniden angelockt. Für Diplopoden, Isopoden und Chilopoden konnte dies nicht nachgewiesen werden (Bíró,

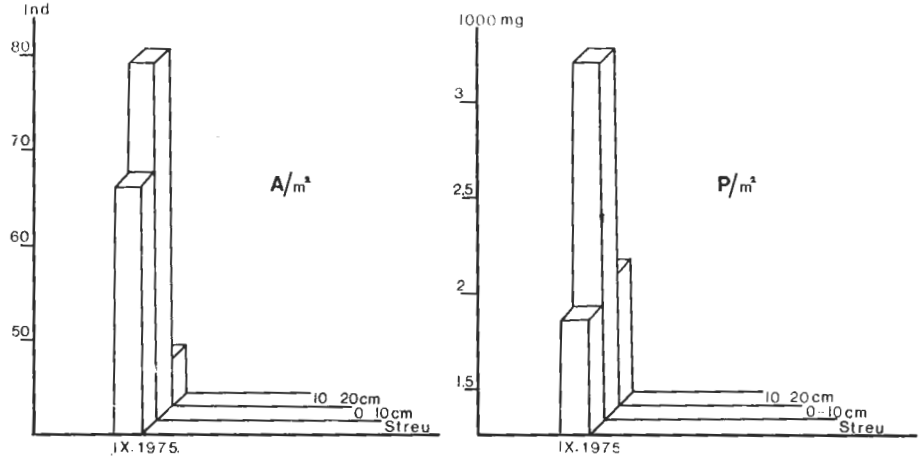


Abb. 6. Abundanz- (A/m²) und Produktionswerte (P/m²) bei den Chilopodengemeinschaften in der Laubstreu in Bodentiefen von 0 – 10 und 10 – 20 cm

1969). Die mit vier verschiedenen Flüssigkeiten (Ethylenglykol, Ethylenglykol + Fleischköder, 4%-Formol und Salzwasser) durchgeführten vergleichenden Fanguntersuchungen brachten für die von uns untersuchten Tiergruppen nahezu die gleichen Ergebnisse. Allein die jeweilige Aktivität der Tiere beeinflusst die Menge der in die Fallen geratenen Individuen, so dass aus unseren Fallenfang-Ergebnissen allein auf die Aktivität in den verschiedenen Untersuchungsperioden gefolgert kann. Ausserdem ist es uns durch den Fallenfang gelangen auch solche Arten nachzuweisen, die mit der quantitativen Sammelmethode nicht erbeutet werden konnten.

Die Ergebnisse des Fallenfanges werden nur in Bezug auf die Asseln und Diplopoden gewertet, da Chilopoden nur vereinzelt vorkomen und auch dann nur solche Arten, die bisher mit der quantitativen Methode ebenfalls erbeutet werden konnten.

Von den Asseln wurden in den Fallen die Arten *P. collicola*, *P. amoenus* und *O. planum* erbeutet, in höherer Individuenzahl nur die letztere (minimum 3, maximum 21 Exemplare).

Von den Diplopoden konnten weitere drei Arten im Untersuchungsgebiet nachgewiesen werden, es sind dies: *Glomeris hexasticha* Brandt, *Julus scandinavius* Brandt, *Brachydesmus* sp. juv. Von allen drei Arten sind nur einige Exemplare gefangen worden. Aussagungen bezüglich ihrer Aktivität können nicht gemacht werden.

Cylindroiulus boleti, die während der quantitativen Aufsammlungen nur bei einer Gelegenheit gesammelt werden konnte, war in den Fallen – wenn auch nur mit wenigen Exemplaren – stets vertreten. Dies lässt sich mit der interessanten Lebensweise dieser Art erklären. *C. boleti* ist keine ausgesprochene streubewohnende Art, sie lebt in morschen Holzteilen, Baumstümpfen und konnte so mit der üblichen Fangmethode nicht gefangen werden. Ausserdem bewegt sie sich in der Nacht und ist so in die Fallen geraten. Jungtiere konnten vom Oktober angefangen in den Fallen angetroffen werden.

Tabelle 6. Die Individuenzahl von Chromatoiulus projectus in den 10 Bodenfallen der verschiedenen Untersuchungsmonate

1974							
V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
75	94	119	106	84	30	18	7

1975		
I.	II.	III.
2	3	14

Polydesmus complanatus ist ebenfalls in grösserer Anzahl in den Fallen angetroffen worden als bei den quantitativen Aufnahmen. Dies hängt ebenfalls mit der Lebensweise dieser Art zusammen, da sie hauptsächlich in Baumstümpfen lebt und sich vorwieglich nachts bewegt.

Massenhaft konnten in den Fallen die Vertreter der Art *Chromatoiulus projectus* nachgewiesen werden, so dass bezüglich ihrer Aktivität Folgerungen gezogen werden können. Die Verteilung der Geschlechter lässt ebenfalls interessante Feststellungen machen. Eine intensivere Aktivität dieser Art beginnt im April, was mit den günstigeren Temperatur-Verhältnissen in Verbindung gebracht werden kann. Im Juli erreicht sie die höchsten Individuenzahlen in den Fallen, ein Minimum konnte im November bis März festgestellt werden. In Tabelle 5 fessen wir die Zahl der in den 10 Fallen angetroffenen Individuen den Monaten entsprechend zusammen.

Interessant ist die Feststellung, dass in der maximalen Aktivitätszeit das Verhältnis der Männchen und Weibchen nahezu gleich war:

Juli: 24 ♂, 31 ♀, 64 juvenile Tiere; August: 20 ♂, 18 ♀, 68 juvenile Tiere.

Wie aus den Angaben zu ersehen, ist die Aktivität der beiden Geschlechter und der juvenilen Tiere nahezu gleich, wenn auch die absolute Menge der letzteren bedeutend höher ist. Aus diesen Angaben geht ferner noch hervor, dass die Paar-Wahl bei dieser Art anderes verläuft wie bei den Spinnen, wo die Männchen eine bedeutend grössere Aktivität aufweisen, da ihr Zahl in den Fallen immer viel höher ist.

Zusammenfassung

In der vorliegenden Arbeit werden die strukturzönologischen Ergebnisse bezüglich der Oniscoiden, Diplopoden und Chilopoden Gemeinschaften eines etwa 60-jährigen Traubeneichen-(Zerreichen-)Bestandes (Quercetum petraeae-cerris) bekanntgegeben.

Die Oniscoiden sind mit drei Arten vertreten, ihre Individuendichte ist jedoch äusserst niedrig, so auch ihr Anteil an der Zersetzung der Laubstreu. Die Diplopoden sind mit neun Arten vertreten, die höchsten Individuenzahlen konn-

ten bei *Chromatoiulus projectus* festgestellt werden. Bedeutend ist noch die sich rasch entwickelnde *Heteroporatia bosniense*, sowie *Polyzonium germanicum*. Aufgrund von vorausgehenden Untersuchungen anderer Autoren wird diesen streuzersetzenden Arten jährlich von der Gesamtstreu ein Konsum von 5–6% zugemessen.

Die Chilopoden-Gemeischaft wird von 14 Arten gebildet. Vertikale Untersuchungen den Nachweis, das die Lithobiomorphen-Arten ausschliesslich in der Laubstreu leben, die Scolopendromorphen Arten zum grösstenteils ebenfalss da und in der obersten humosen Bodenschicht. Die Geophilomorphen Arten leben hauptsächlich im Boden, die höchsten Individuenzahlen konnten in einer Tiefe von 10 cm nachgewiesen werden. Von den Lithobiomorphen erwies sich *L. mutabilis* als dominant, zu gewissen Perioden tritt *L. muticus* als condominante Art auf. Bedeutend ist noch die Individuendichte von *M. aeruginosus*. Von den Geophilomorphen erreichte *S. nemorensis* die höchste Individuenzahl, während *C. flavidus*, die ebenfalls zahlreich angetroffen werden konnte, schon wegen ihrer Körpergrösse als räuberisches Element in der Nahrungskette eine ausschlaggebende Bedeutung besitzt. Eine bedeutendere Art ist noch *H. illyrica*.

SCHRIFTTUM

1. Balogh, J. (1958): *Lebensgemeinschaften der Landtiere.* – Budapest – Berlin, 1 – 560.
2. Gere, G. (1956): *The examination of feeding biology and humificative function of Diplopoda and Isopoda.* – Acta Biol. Sci. Hung., 6: 257 – 271.
3. Jakucs, P. (1973) *„Sikfőkút Project". Egy tölgyes-ökoszisztéma környezetbiológiai kutatása a bioszféra-program keretén belül.* – MTA Oszt. Közl., 16: 11 – 25.
4. Loksa, I. (1966): *Die bodenzoozönologischen Verhältnisse der Flaumeichen-Buschwälder Südosmitteleuropas.* – Budapest, 1 – 437.
5. Loksa, I. (1968): *Quantitative Makrofauna – Untersuchungen in den Waldböden des Bükkgebirges (Ungarn).* – Ann. Univ. Sci. Budapest, 9 – 10: 265 – 289.
6. Papp, L. (1972): *Az avarprodukció és jelentősége a biológiai produktivitásban.* – Bot. Közl., 59 173 – 180.
7. B. Papp, L. & Tóth, J. A. (1973): *A sikfőkúti cseres-tölgyes 1978. évi avarprodukciójának vizsgálata* – Bot. Közl., 60: 182 – 190.
8. Zicsi, A. (1957): *Ein Bodenstecher zum Einsammeln der Lumbriciden aus Ackerböden.* – Opusc. Zool. Budapest, 2: 71 – 75.

Tabelle 1. Streuschicht, 22. III. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	–	2	–	–	–	–	–	–	2	–	2	3,2	13,33	10	60	96	1,57
Chromatoiulus projectus	1	1	–	–	1	2	4	1	1	–	3	8	11	17,6	73,33	70	3665	5864	96,02
Polizonium germanicum	–	1	–	–	–	–	–	–	1	–	2	–	2	3,2	13,33	20	92	147	2,41
Gesamtwerte der Oniscinen und Diplopoden	1	2	–	2	1	2	4	1	2	–	7	8	15	24,0	99,99		3817	6107	100,00
Chilopoda																			
Lithobius mutabilis	4	1	2	2	–	–	–	1	1	1	5	7	12	19,2	35,29	70	379	606	33,84
Lithobius muticus	3	–	–	–	–	2	–	–	–	1	2	4	6	9,6	17,65	30	155	248	13,48
Monotarsobius aeruginosus	–	–	–	1	1	–	–	–	2	–	1	3	4	6,4	11,76	30	43	69	3,84
Schendyla nemorensis	2	2	1	1	–	–	1	–	1	–	5	3	8	12,8	23,53	60	65	104	5,80
Brachyschendyla montana	–	1	–	–	–	–	–	–	–	–	1	–	1	1,6	2,94	10	12	19	1,07
Clinopodes flavidus	–	–	–	–	–	–	2	–	–	–	2	–	2	3,2	5,88	10	341	546	30,45
Henia illyrica	1	–	–	–	–	–	–	–	–	–	1	–	1	1,6	2,94	10	125	200	11,16
Gesamtwerte der Chilopoden	10	4	3	4	1	2	3	1	4	2	17	17	34	54,4	99,99		1120	1792	100,00

Tabelle 2. Streuschicht, IV. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_z	Fr	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	2	–	–	–	2	–	–	–	–	4	–	4	6,4	20,00	20	120	192	2,59
Chromatoiulus projectus	2	–	2	1	1	3	2	–	2	–	4	9	13	20,8	65,00	70	4410	7056	95,13
Polyzonium germanicum	–	–	–	1	–	–	–	2	–	–	2	1	3	4,8	15,00	20	106	170	2,28
Gesamtwerte der Oniscinen und Diplopoden	2	2	2	2	1	5	2	2	2	–	10	10	20	32,0	100,00		4636	7418	100,00
Chilopoda																			
Lithobius mutabilis	2	–	3	1	1	–	–	1	3	–	6	5	11	17,6	28,95	60	366	586	29,18
Lithobius muticus	–	2	–	–	–	1	–	–	–	–	2	1	3	4,8	7,89	20	115	184	9,17
Lithobius pusillus	–	–	–	–	1	–	–	–	–	–	–	1	1	1,6	2,63	10	5	8	0,40
Monotarsobius aeruginosus	1	–	–	2	1	2	–	–	–	–	4	2	6	9,6	15,79	40	82	131	6,54
Schendyla nemorensis	2	1	3	1	–	–	–	2	2	–	6	5	11	17,6	28,95	60	88	141	7,02
Brachyschendyla montana	–	–	–	–	2	–	–	–	–	–	–	2	2	3,2	5,25	20	14	22	1,12
Clinopodes flavidus	–	–	–	–	–	–	1	–	–	–	1	–	1	1,6	2,63	10	184	294	14.67
Henia illyrica	–	1	–	–	–	–	–	–	–	2	3	–	3	4,8	7,89	20	400	640	31,90
Gesamtwerte der Chilopoden	5	4	6	4	5	3	1	3	5	2	22	16	38	60,8	99,99		1254	2006	100,00

Tabelle 3. Streuschicht, 6. V. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr	G.	P/m²	G.%
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	2	–	–	–	–	–	–	–	2	–	2	3,2	9,09	10	60	96	1,12
Protracheoniscus amoenus	–	–	–	–	–	1	–	–	–	–	–	1	1	1,6	4,55	10	45	72	0,84
Chromatoiulus projectus	2	3	1	–	2	4	1	–	2	–	5	10	15	24,0	68,18	70	5095	8152	95,34
Leptoiulus proximus	–	–	–	1	–	–	–	–	–	–	–	1	1	1,6	4,55	10	70	112	1,31
Polyzonium germanicum	–	–	–	–	–	2	–	1	–	–	1	2	3	4,8	13,63	20	74	118	1,38
Gesamtwerte der Oniscinen und Diplopoden	2	3	3	1	2	7	1	1	2	–	8	14	22	35,2	100,00		5344	8550	99,99
Chilopoda																			
Lithobius mutabilis	2	4	1	3	–	–	2	1	2	–	5	10	15	24,0	33,33	70	415	664	29,14
Lithobius muticus	2	–	–	–	1	3	–	–	–	1	2	5	7	11,2	15,56	40	196	314	13,76
Monotarsobius aeruginosus	1	2	2	1	–	–	3	2	1	–	7	5	12	19,2	26,67	70	136	218	9,55
Schendyla nemorensis	2	–	–	–	3	1	–	–	–	1	5	2	7	11,2	15,56	40	62	99	4,35
Clinopodes flavidus	–	1	–	1	–	–	–	–	–	–	2	–	2	3,2	4,44	20	360	576	25,28
Henia illyrica	–	–	1	–	–	–	–	–	1	–	2	–	2	3,2	4,44	20	255	408	18,91
Gesamtwerte der Chilopoden	7	7	4	5	4	4	5	3	4	2	23	22	45	72,0	100,00		1424	2278	99,99

Tabelle 4. Streuschicht, 4. VI. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_z	Fr	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	–	–	–	1	–	–	–	–	1	–	1	1,6	8,33	10	30	48	0,90
Chromatoiulus projectus	2	1	–	2	1	–	2	–	1	–	2	8	10	16,0	83,33	60	3284	5254	98,68
Polyzonium germanicum	–	–	–	–	–	–	1	–	–	–	–	1	1	1,6	8.33	10	14	22	0,42
Gesamtwerte der Oniscinen und Diplopoden	2	1	–	2	1	1	3	–	1	–	3	9	12	19,2	99,99		3328	5324	100,00
Chilopoda																			
Lithobius forficatus	–	–	–	–	–	–	–	–	1	–	1	–	1	1,6	1,82	10	356	570	15,99
Lithobius mutabilis	–	2	2	1	–	3	4	–	2	2	9	7	16	25,6	29,09	70	536	858	24,07
Lithobius muticus	–	–	1	1	2	1	2	1	1	–	4	5	9	14,4	16,36	70	284	454	12,75
Monotarsobius aeruginosus	2	–	–	–	3	2	1	–	3	4	13	2	15	24,0	27,27	60	244	390	10,96
Cryptops hortensis	–	1	–	1	–	–	1	–	–	–	2	1	3	4,8	5,45	30	72	115	3,23
Schendyla nemorensis	–	1	1	–	–	–	–	2	–	1	3	2	5	8,0	9,09	40	42	67	1,88
Clinopodes flavidus	–	–	–	–	–	1	–	–	–	2	3	–	3	4,8	5,45	20	536	858	24,07
Henia illyrica	–	–	–	–	–	–	1	–	–	–	1	–	1	1,6	1,82	10	125	200	5,61
Gesamtwerte der Chilopoden	2	4	4	3	7	7	9	3	7	9	38	17	55	88,0	99,99		2227	3563	100,00

Tabelle 5. Streuschicht, 1. VII. 1974.

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr	G.	P/m²	G.%
Oniscinea + Diplopoda																			
Porcellium collicola	1	1	3	–	–	–	–	1	1	–	2	5	7	11,2	25,0	50	145	232	4,04
Protracheoniscus amoenus	–	–	–	1	–	–	–	–	–	–	–	1	1	1,6	3,57	10	50	80	1,39
Heteroporatia bosniense	2	–	–	–	2	1	–	2	–	–	–	7	7	11,2	25,00	40	126	202	3,51
Chromatoiulus projectus	2	4	–	–	1	3	–	–	1	2	2	11	13	20,8	46,42	60	3266	5226	91,05
Gesamtwerte der Oniscinen und Diplopoden	5	5	3	1	3	4	–	3	2	2	4	24	28	44,8	100,00		3587	5739	99,99
Chilopoda																			
Lithobius mutabilis	5	3	1	–	2	4	2	3	2	3	8	17	25	40,0	40,98	90	701	1122	37,67
Lithobius muticus	4	–	2	–	–	3	–	3	2	–	3	11	14	22,4	22,95	50	275	440	14,78
Monotarsobius aeruginosus	1	1	–	1	–	1	–	1	–	–	1	4	5	8,0	8,20	50	46	74	2,74
Cryptops hortensis	–	–	1	–	–	–	1	–	–	–	1	1	2	3,2	3,28	20	45	72	2,42
Cryptops anomalans	–	–	–	–	1	–	–	–	–	–	–	1	1	1,6	1,64	10	70	112	3,76
Schendyla nemorensis	–	1	–	–	–	1	–	–	–	–	–	2	2	3,2	3,28	20	12	19	0,64
Geophilus proximus	–	–	–	–	–	–	1	1	–	–	–	2	2	3,2	3,28	20	12	19	0,64
Clinopodes flavidus	–	–	1	1	–	1	–	2	1	2	4	4	8	12,8	13,11	60	652	1043	35,03
Henia illyrica	–	–	1	–	–	–	1	–	–	–	–	2	2	3,2	3,28	20	48	77	2,58
Gesamtwerte der Chilopoden	10	5	6	2	3	10	5	10	5	5	17	44	61	97,6	100,00		1861	2978	99,99

Bodenschicht (1 – 20 cm)

Chilopoda																			
Shendyla nemorensis	2	3	4	2	3	9	6	6	2	5	15	27	42	67,2	70,00	10	282	451	20,66
Brachyschendyla-montana	–	–	–	1	–	–	1	–	–	–	2	–	2	3,2	3,33	20	24	38	1,76
Clinopodes flavidus	–	1	4	2	2	1	2	–	–	1	3	8	11	17,6	18,33	60	702	1123	51,43
Geophilus proximus	1	1	–	–	–	–	–	–	–	–	2	–	2	3,2	3,33	20	160	256	11,72
Henia illyrica	1	–	–	–	1	–	1	–	–	–	1	2	3	4,8	5,00	30	197	315	14,43
Gesamtwerte der Chilopoden	4	5	8	5	5	11	8	6	2	6	23	37	60	96,0	99,99		1365	2184	100,00

Tabelle 6. Streuschicht, 29. VII. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	2	–	–	–	1	–	–	–	1	2	3	4,8	15,79	20	64	102	1,74
Heteroporatia bosniense	–	–	–	–	–	2	–	–	3	–	–	5	5	8,0	20,32	20	100	160	2,73
Chromatoiulus projectus	1	–	2	–	1	–	3	–	–	3	3	7	10	16,0	52,63	50	3463	5541	94,39
Leptoiulus proximus	–	–	–	–	–	–	1	–	–	–	–	1	1	1,6	5,26	10	42	67	1,14
Gesamtwerte der Oniscinen und Diplopoden	1	–	4	–	1	2	5	–	3	3	4	15	19	30,4	100,00		3669	5870	100,00
Chilopoda																			
Lithobius mutabilis	–	2	–	3	4	2	–	1	2	–	6	8	14	22,4	56,00	60	386	618	43,71
Lithobius muticus	–	–	–	–	2	–	1	1	–	–	1	3	4	6,4	16,00	30	103	164	11,60
Monotarsobius aeruginosus	–	–	–	1	–	–	–	1	–	–	2	–	2	3,2	8,00	20	36	58	4,10
Cryptops anomalans	–	–	–	–	–	1	–	–	–	–	1	–	1	1,6	4,00	10	280	448	31,68
Scolioplanes transsylvanicus	–	–	–	–	–	–	–	2	–	–	1	1	2	3,2	8,00	20	59	94	6,65
Schendyla nemorensis	–	–	–	–	1	–	–	–	–	1	2	–	2	3,2	8,00	20	20	32	2,26
Gesamtwerte der Chilopoden	–	2	–	4	7	3	1	5	2	1	13	12	25	40,0	100,00		884	1414	100,00

Tabelle 7. Streuschicht, 9. IX. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	1	1	–	–	1	–	1	1	–	1	1	5	6	9,6	18,18	60	115	184	2,18
Protracheoniscus amoenus	–	–	–	–	–	–	–	1	–	–	–	1	1	1,6	3,03	10	50	80	0,95
Heteroporatia bosniense	1	–	–	–	–	–	1	–	–	2	4	–	4	6,4	12,12	30	168	269	3,18
Chromatoiulus projectus	1	7	3	1	2	–	1	4	–	–	5	14	19	30,4	57,58	70	4813	7701	91,16
Leptoiulus proximus	–	–	–	–	–	–	–	–	2	–	–	2	2	3,2	6,06	10	120	192	2,27
Polyzonium germanicum	–	–	–	–	–	–	–	–	–	1	–	1	1	1,6	3,03	10	14	22	0,26
Gesamtwerte der Oniscinen und Diplopoden	3	8	3	1	3	–	3	5	2	4	10	23	33	52,8	100,00		5280	8448	100,00
Chilopoda																			
Lithobius mutabilis	3	3	–	2	1	2	3	–	2	1	8	9	17	27,2	32,69	80	524	838	33,55
Lithobius muticus	3	4	2	1	–	–	–	2	–	–	6	6	12	19,2	23,07	50	342	547	21,90
Monotarsobius aeruginosus	–	–	1	–	–	–	1	1	–	3	4	2	6	9,6	11,54	40	82	131	5,25
Cryptops hortensis	–	–	1	–	–	–	–	1	–	–	1	1	2	3,2	3,85	20	45	72	2,88
Schendyla nemorensis	1	2	–	–	1	–	1	4	–	1	2	8	10	16,0	19,23	60	68	109	4,35
Brachyschendyla montana	–	–	–	–	–	–	–	1	–	1	1	1	2	3,2	3,85	20	16	26	1,02
Clinopodes flavidus	–	–	–	–	–	1	–	–	1	–	2	–	2	3,2	3,85	20	360	576	23,05
Henia illyrica	1	–	–	–	–	–	–	–	–	–	–	1	1	1,6	1,92	10	125	200	8,00
Gesamtwerte der Chilopoden	8	9	4	3	2	3	5	9	3	6	24	28	52	83,2	100,00		1562	2499	100,00

Tabelle 8. Streuschicht, 9. X. 1974

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	1	–	–	–	3	–	–	–	1	–	2	3	5	8,0	15,63	30	97	155	1,76
Heteroporatia bosniense	–	–	2	–	–	–	–	1	–	–	3	–	3	4,8	9,38	20	126	202	2,29
Chromatoiulus projectus	1	6	2	–	3	–	2	4	2	–	3	17	20	32,0	62,50	70	5132	8211	93,26
Leptoiulus proximus	–	–	–	–	–	2	–	–	–	–	–	2	2	3,2	6,25	20	120	192	2,18
Polyzonium germanicum	–	–	–	–	–	1	–	–	–	1	–	2	2	3,2	6,25	20	28	45	0,51
Gesamtwerte der Oniscinen und Diplopoden	2	6	4	–	6	3	2	5	3	1	8	24	32	51,2	100,00		5503	8805	100,00
Chilopoda																			
Lithobius mutabilis	–	1	2	3	1	–	1	1	1	–	5	5	10	16,0	35,71	70	360	576	42,30
Lithobius muticus	1	–	1	–	–	2	–	1	1	–	1	5	6	9,6	21,43	50	133	213	15,63
Monotarsobius aeruginosus	–	–	1	–	2	–	–	–	–	1	3	1	4	6,4	14,29	30	60	96	7,05
Cryptops hortensis	–	–	–	–	–	–	–	–	1	1	–	2	2	3,2	7,14	20	32	51	3,76
Schendyla nemorensis	–	–	–	3	–	–	1	–	–	–	3	1	4	6,4	14,29	20	36	58	4,23
Clinopodes flavidus	–	–	1	–	–	–	–	–	–	1	1	1	2	3,2	7.14	20	230	368	27,03
Gesamtwerte der Chilopoden	1	1	5	6	3	2	2	2	3	3	13	15	28	44,8	100,00		851	1362	100,00
Bodenschicht. (1 – 20 cm)																			
Chilopoda																			
Schendyla nemorensis	–	4	2	5	1	4	2	2	1	3	14	10	24	38,4	60,00	90	185	296	11,38
Brachyschendyla montana	–	–	–	1	–	–	–	–	–	–	–	1	1	1,6	2,50	10	6	10	0,37
Clinopodes flavidus	2	–	1	1	–	2	1	–	1	–	5	3	8	12,8	20,00	60	852	1363	52,43
Geophilus proximus	–	2	1	–	–	–	–	–	–	1	2	2	4	6,4	10,00	30	200	320	12,31
Henia illyrica	1	–	–	–	1	–	–	–	1	–	3	–	3	4,8	7,50	30	382	611	23,51
Gesamtwerte der Chilopoden	3	6	4	7	2	6	3	2	3	4	24	16	40	64,0	100,00		1625	2600	100,00

Tabelle 9. Streuschicht, 16. IV. 1975

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	1	–	1	–	1	–	–	–	–	3	–	3	4,8	15,79	30	90	144	2,70
Orthometopon planum	–	–	–	–	–	–	–	–	1	–	1	–	1	1,6	5,26	10	54	86	1,62
Chromatoiulus projectus	2	–	1	–	–	2	1	1	3	2	2	10	12	19,2	63,16	70	3046	4847	91,47
Polyzonium germanicum	–	–	2	1	–	–	–	–	–	–	3	–	3	4,8	15,79	20	140	224	4,20
Gesamtwerte der Oniscinen und Diplopoden	2	1	3	2	–	3	1	1	4	2	9	10	19	30,4	100,00		3330	5328	99,99
Chilopoda																			
Lithobius mutabilis	2	2	2	–	3	–	–	–	–	1	6	4	10	16,0	29,52	50	358	573	25,44
Lithobius muticus	–	–	1	–	1	–	–	2	–	–	2	2	4	6,4	11,76	30	138	221	9,81
Lithobius agilis	–	–	–	–	–	–	–	–	–	1	1	–	1	1,6	2,94	10	36	58	2,56
Monotarsobius aeruginosus	–	–	1	1	–	–	1	–	–	1	3	1	4	6,4	11,76	40	60	96	4,26
Cryptops anomalans	–	–	–	1	–	–	–	–	–	–	–	1	1	1,6	2,94	10	54	86	3,84
Schendyla nemorensis	2	3	–	–	–	2	–	1	–	1	6	3	9	14,4	26,47	50	69	110	4,90
Clinopodes flavidus	–	–	1	–	–	–	–	–	–	–	1	–	1	1,6	2,94	10	182	291	12,94
Henia illyrica	1	–	–	–	–	–	3	–	–	–	4	–	4	6,4	11,76	20	510	816	36,25
Gesamtwerte der Chilopoden	5	5	5	2	4	2	4	3	–	4	23	11	34	54,4	99,99		1407	2251	100,00
Bodenschicht (1 – 20 cm)																			
Schendyla nemorensis	–	2	–	2	–	1	5	2	3	1	10	6	16	25,6	47,06	70	127	203	100,00
Brachyschendyla montana	–	–	1	–	1	–	–	–	–	–	2	–	2	3,2	5,88	20	24	38	1,27
Clinopodes flavidus	2	4	–	1	1	1	–	1	1	2	8	5	13	20,8	38,24	80	1486	2378	78,96
Geophilus proximus	–	–	1	–	–	–	–	–	–	–	1	–	1	1,6	2,94	10	80	128	4,25
Henia illyrica	–	–	–	–	–	1	–	–	–	1	1	1	2	3,2	5,88	20	165	264	8,77
Gesamtwerte der Chilopoden	2	6	2	3	2	3	5	3	4	4	22	12	34	54,4	100,00		1882	3011	100,00

Tabelle 10. Streuschicht, 4. VII. 1975

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G.	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	2	–	1	–	–	–	–	–	1	4	5	8,0	19,23	30	92	147	2,55
Protracheoniscus amoenus	–	–	–	1	–	–	–	–	–	–	–	1	1	1,6	3,85	10	16	26	0,44
Polydesmus complanatus	–	1	–	–	–	–	–	–	–	–	–	1	1	1,6	3,85	10	58	93	1,61
Chromatoiulus projectus	1	3	–	2	5	–	3	–	2	–	2	14	16	25,6	61,53	60	3345	5352	92,68
Leptoiulus proximus	–	–	–	–	–	1	–	–	–	–	–	1	1	1,6	3,85	10	70	112	1,94
Polyzonium germanicum	–	–	–	2	–	–	–	–	–	–	–	2	2	3,2	7.69	10	28	45	0,78
Gesamtwerte der Oniscinen und Diplopoden	1	4	2	5	6	1	3	–	2	–	3	23	26	41,6	100,00		3609	5774	100,00
Chilopoda																			
Lithobius mutabilis	2	1	4	2	2	–	3	–	1	3	6	12	18	28,8	60,00	80	445	712	39,77
Lithobius muticus	–	2	–	–	1	1	–	1	–	–	2	3	5	8,0	16,67	40	125	200	11,17
Monotarsobius aeruginosus	–	–	2	–	–	–	1	–	–	–	2	1	3	4,8	10,00	20	50	80	4,47
Schendyla nemorensis	–	–	–	1	–	–	–	–	–	–	1	–	1	1,6	3,33	10	10	16	0,89
Clinopodes flavidus	–	–	–	–	2	–	–	–	–	–	2	–	2	3,2	6,67	20	364	582	32,53
Henia illyrica	–	–	–	–	1	–	–	–	–	–	1	–	1	1,6	3,33	10	125	200	11,17
Gesamtwerte der Chilopoden	2	3	6	3	6	1	4	1	1	3	14	16	30	48,0	100,00		1119	1790	100,00

Bodenschicht (1 – 20 cm)

Chilopoda																			
Schendyla nemorensis	2	7	5	9	2	8	1	2	1	3	12	28	40	64,0	62,60	10	257	411	11,38
Brachyschendyla montana	–	–	–	–	2	–	–	–	–	–	1	1	2	3,2	3,13	10	18	29	0,79
Clinopodes flavidus	2	3	2	–	–	2	4	2	–	2	7	10	17	27,2	26,56	70	1531	2449	67,78
Geophilus proximus	–	–	–	1	–	–	–	–	–	–	1	–	1	1,6	1,56	10	80	128	3,54
Henia illyrica	–	–	–	2	–	–	–	–	2	–	2	2	4	6,4	6,25	20	373	597	16,51
Gesamtwerte der Chilopoden	4	10	7	12	4	10	5	4	3	5	23	41	64	102,4	100,00		2259	3614	100,00

Tabelle 11. Streuschicht, 6. IX. 1975

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G_2	P/m²	G.%
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	–	2	–	–	–	1	–	1	1	3	4	6,4	14,29	30	81	130	1,87
Heteroporatia bosniensis	1	1	–	–	–	–	2	1	–	–	5	–	5	8,0	17,86	40	210	336	4,84
Polydesmus complanatus	–	1	–	–	–	–	–	–	–	–	–	1	1	1,6	3,57	10	186	298	4,28
Chromatoiulus projectus	–	1	2	1	3	1	–	4	–	3	3	12	15	24,0	53,57	70	3757	6011	86,57
Polyzonium germanicum	–	–	–	1	1	–	–	1	–	–	2	1	3	4,8	10,71	30	106	170	2,44
Gesamtwerte der Oniscinen und Diplopoden	1	3	2	4	4	1	2	7	–	4	11	17	28	44,8	100,00		4340	6945	100,00
Chilopoda																			
Lithobius forficatus	–	–	–	–	–	1	–	–	–	–	–	1	1	1,6	2,38	10	230	368	19,78
Lithobius mutabilis	–	1	–	4	1	3	2	–	2	–	3	10	13	20,8	30,96	60	287	459	24,68
Lithobius muticus	1	–	–	–	2	–	–	–	–	–	1	2	3	4,8	7,14	20	90	144	7,73
Monotarsobius aeruginosus	1	1	1	1	2	2	–	–	–	1	5	4	9	14,4	21,43	70	110	176	9,46
Cryptops hortensis	–	–	1	–	1	–	–	1	–	–	1	2	3	4,8	7,14	30	61	98	5,25
Cryptops anomalans	–	–	1	–	–	–	–	–	–	–	–	1	1	1,6	2,38	10	74	118	6,36
Schendyla nemorensis	2	2	–	2	2	–	–	–	1	–	4	5	9	14,4	21,43	50	55	88	4,73
Clinopodes flavidus	1	–	–	–	–	–	–	–	–	–	1	–	1	1,6	2,38	10	176	282	15,13
Henia illyrica	–	–	1	–	–	–	1	–	–	–	–	2	2	3,2	4,76	20	80	128	6,88
Gesamtwerte der Chilopoden	5	4	4	7	8	6	3	1	3	1	15	27	42	67,2	100,00		1163	1861	100,00
Bodenschicht (1 – 20 cm)																			
Chilopoda																			
Cryptops hortensis	–	–	–	–	–	–	–	1	–	–	–	1	1	1,6	1,28	10	16	26	0,44
Schendyla nemorensis	2	1	7	5	3	1	1	5	9	4	22	16	38	60,8	48,72	10	280	448	7,68
Brachyschendyla montana	1	–	1	–	–	–	–	1	–	1	1	3	4	6,4	5,13	40	25	40	0,68
Clinopodes flavidus	1	1	–	3	1	1	1	2	–	6	11	5	16	25,6	20,51	80	1972	3155	54,06
Geophilus proximus	1	–	2	1	1	–	2	–	2	–	6	3	9	14,4	11,54	60	540	864	14,80
Henia illyrica	–	1	1	1	1	1	2	–	3	–	5	5	10	16,0	12,82	70	815	1304	22,34
Gesamtwerte der Chilopoden	5	3	11	10	6	3	6	9	14	11	45	33	78	124,8	100,00		3648	5837	100,00

Tabelle 12. Streuschicht, 8. XI. 1975

Spezies	1	2	3	4	5	6	7	8	9	10	a.	j.	S.	A/m²	D_2	Fr.	G_2	P/m²	G.‰
Oniscinea + Diplopoda																			
Porcellium collicola	–	–	2	–	–	3	–	–	–	–	–	5	5	8,0	20,00	20	85	136	1,79
Heteroporatia bosniense	–	1	–	1	1	–	–	–	1	–	4	–	4	6,4	16,00	40	168	269	3,72
Chromatoiulus projectus	2	–	4	1	–	3	–	3	–	–	3	10	13	20,8	52,00	50	4124	5698	91,46
Cylindroiulus boleti	–	–	–	–	–	–	1	–	–	–	–	1	1	1,6	4,00	10	26	41	0,58
Leptoiulus proximus	–	–	–	–	–	–	–	–	1	–	–	1	1	1,6	4,00	10	60	96	1,33
Polyzonium germanicum	–	–	–	–	–	–	1	–	–	–	1	–	1	1,6	4,00	10	46	73	1,02
Gesamtwerte der Oniscinen und Diplopoden	2	1	6	2	1	6	2	3	2	–	8	17	25	40,0	100,00		4509	7214	100,00
Chilopoda																			
Lithobius forficatus	–	–	–	–	1	–	–	–	–	–	–	1	1	1,6	2,63	10	138	221	11,90
Lithobius mutabilis	2	3	–	–	3	4	2	–	–	3	5	12	17	27,2	44,74	6	342	547	29,51
Lithobius muticus	–	1	2	–	–	–	1	3	–	–	3	4	7	11,2	18,42	40	192	307	16,57
Monotarsobius aeruginosus	1	–	–	2	–	–	–	–	2	–	2	3	5	8,0	13,16	30	51	82	4,40
Cryptos anomalans	–	–	–	–	1	–	–	–	–	–	–	1	1	1,6	2,63	10	60	96	5,18
Cryptops hortensis	1	–	–	–	–	1	–	–	–	–	1	1	2	3,2	5,26	20	45	72	3,88
Schendyla nemorensis	–	–	2	–	–	1	–	–	–	–	3	–	3	4,8	7,89	20	30	48	2,59
Clinopodes flavidus	–	–	–	–	–	–	–	–	1	–	1	–	1	1,6	2,63	10	176	281	15,18
Henia illyrica	–	1	–	–	–	–	–	–	–	–	1	–	1	1,6	2,63	10	125	200	10,79
Gesamtwerte der Chilopoden	4	5	4	2	5	6	3	3	3	3	16	22	38	60,8	99,99		1159	1854	100,00
Bodenschicht (1 – 20 cm)																			
Schendyla nemorensis	2	6	3	4	8	2	4	1	2	3	20	15	35	56,0	51,47	100	273	437	8,07
Brachyschendyla montana	–	–	–	–	–	2	–	2	–	–	3	1	4	6,4	5,88	20	36	58	1,05
Clinopodes flavidus	–	–	3	4	–	3	2	–	4	2	10	8	18	28,8	26,47	60	2024	3238	59,85
Geophilus proximus	–	1	–	–	1	–	–	–	–	–	2	–	2	3,2	2,94	20	160	256	4,73
Henia illyrica	3	–	–	–	2	–	–	2	2	–	4	5	9	14,4	13,24	40	889	1422	26,29
Gesamtwerte der Chilopoden	5	7	6	8	11	7	6	5	8	5	39	29	68	108,8	100,00		3382	5411	100,00